ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXIII. No. 22.

TABLE OF CONTENTS.

Engineering News of the Week 505, 506, 509, 513

Technical and Illustrated Articles:

An Experimental Study of Atmospheric Resistance 506
The New Pumping Engines, Chicago, Ill. 506
Stone Arch at Elyria, O. 506
The Public Works' Controversy in Providence 507
The Mekarski Compound Air Tramway Motor 507
Plans for the Sewerage of Orange, N. J. 509
Public Works in Siam 509
Brake Shoe Tests and Testing Machine 510
An Experience in the Sinking of Foundations 511
The Proposed Montreal Bridge 511
Street Cleaning in Berlin 511
Forestry Interests of the United States 511
Joints for Steel "Spiral Weld" Pipes 512
A Standard Method of Conducting Duty Trials of Pumping Engines (*Concluded*) 518
A Universal Steam Calorimeter 520

Personals, Society Proceedings 513, 515

Editorial Notes 516

An Advertisement Corrected—A "Hedge"—Brake Shoe Tests—Crosby's Experiments in Air Resistance—The River and Harbor Bill.

Editorials:

The Chicago Convention of American Water-Works Superintendents 516
Bridge vs. Tunnel for the Hudson River 517
The Hatteras Light Contract 517

Correspondence 518

Finding Depth of Half-Area of Trapezoidal Section—A Successful Car-Coupler Test—Water-Works of Ypsilanti, Mich.

Railways, Rapid Transit, Highways, Water-Works, Bridges, Tunnels and Canals, Electrical, Sewerage and Municipal, Contracting, Proposals Open, Manufacturing and Technical 522, 528

THE CHICAGO FINANCE COMMITTEE is discussing the feasibility of extending the Lake View water tunnel 2 miles further into Lake Michigan. Immediate action is dependent on the funds at the disposal of the Comptroller.

THE BEAR RIVER CANAL is approaching completion. The surveys for this work were commenced in Feb. 1889, by Mr. JOHN R. BOTHWELL; on July 20, contracts were let to WM. GORLAND for about 6 miles of work, and the East Canal was to be extended to Ogden and the West to Corinne with a branch into the Malad Valley. Both canals were to be finished by June 30, 1890, but this date is abandoned. The canal engineer was Mr. FRED. MATHYAS until December last. After letting the first 6 miles the company attempted to do the rest themselves, but found this too expensive and new contracts were let. There are now, says the Denver *Tribune*, about 2,000 men at work on the canal and railroad cut-off. Five tunnels on the West canal and two on the East are being driven. A 15ft. dam of stone and cribwork is being built. Mr. ELLWOOD MEAD, of Ogden, is the consulting engineer.

THE MISSOURI RIVER POWER CO. proposes to transmit to Helena, Mont., 25,000 H. P. by a 30 ft. dam in the river, near Canyon Ferry. The river there is 225 ft. wide and is bounded on one side by an 80-ft. cliff, and on the other side the ground rises 6 ft. per 100. The velocity of the water is 4 miles per hour. No definite plans or estimate of cost have yet been made, but the company proposes to issue $500,000 of capital stock and to purchase a site for a power station in Helena, a 500 H. P. steam plant, and to contract for electrical machinery sufficient to distribute 500 H. P. I. H. LAWRENCE, of Independence, Mo., is chairman of the executive committee.

TO REBUILD THE LEVEES, says the State Engineer of Louisiana, and to strengthen existing levees to a standard, would cost at least $2,000,000 on the 300 miles of frontage of that State. To foot this bill the State has a possible revenue of $540,000; but as all overflowed land is exempt from taxes for one year, this sum will be decreased. Chief Engineer STERLING, says that in his Lower Mississippi district, with a frontage of 200 miles, it would cost $2,000,000 to raise and strengthen the levees. The Vicksburg Levee Convention said it would cost $10,000,000 to repair and rebuild the levees of Louisiana, Arkansas and Mississippi.

THE NEW WALNUT ST. BRIDGE, in Philadelphia, across the Schuylkill river, is giving trouble to the contractors for the foundations, I. H. Hathaway & Co. This firm sublet the four coffer-dams to Mr. JAMES E. ROBINSON who attempted to build a round coffer-dam, on the barrel plan, similar to the one he successfully used in founding the piers for the Baltimore & Ohio bridge over the same river, nearer to its mouth. This dam at Walnut St. has given away three times owing to the great depth required, and plans for a new dam are being prepared. The contract price for the four piers was $120,000, and they were to be finished on Sept. 27, 1890. The three other coffer-dams are square, but the one on the west bank is also leaking badly.

THE UNION RAILROAD BRIDGE, at Wheeling, W. Va. now under erection, had the false works of the central span swept away by flood on May 25. This false work was 520 ft. long, 70 ft. wide and 105 ft. high and about 400 tone of steel superstructure were upon it at the time. No lives were lost as all had ample warning. The Baird Bros. of Pittsburg, the well known bridge erectors who put up the Poughkeepsie and other great bridges, were the contractors, and h nce it is scarcely necessary to say that every precaution had been taken to avert failure. The adjoining spans were finished and in 10 days more the central span would have been safe. The loss is reported at about $30,000.

THE LONGEST BRIDGE IN THE WORLD, according to the *Zeitschrift fur Transportwesen*, is the "Lion Bridge" in China. This spans an arm of the Yellow Sea, which reaches far into the interior near the city of Sangang, and has a length of 4.35 miles. It was built by order of the Emperor Kieng Long, who abdicated the throne in 1798 on account of old age. The roadway lies 72 feet above the sea level, and is guarded by iron railings, the structure being carried by 300 large stone arches. It takes its name from the fact that a huge stone lion, 21 ft. long, is placed upon each pier, the lions being cut from single pieces of marble. The Chinese call it the "Wonder of the World."

EARNINGS OF THE BROADWAY, N. Y., CAR LINE for the quarter ending March 31 show: Gross earnings, $383,567; operating expenses, $235,840; net earnings, $147,727; fixed charges, $92,557; surplus $55,169; cash on hand, $190,487; profit and loss surplus, $155,968.

THE MEIGS ELEVATED ROAD BILL has been endorsed by the Massachusetts Legislature by a practically unanimous vote. The bill requires approval of the railway commissioners, the payment of damages by corporations building elevated roads and Boston Common is excepted in its location. The bill is ordered to a third reading.

THE BALTIMORE BELT RAILROAD is likely to go forward to construction. It is one of the most interesting pieces of work at present contemplated. It is only about 7 miles long, but involves an expenditure of about $800,000 per mile. There will be a tunnel almost a mile and a half long under the city, and two shorter tunnels in the northern section of the city, and on the whole route there will not be a single street crossed at grade.

FURTHER DETAILS IN REGARD TO THE ATCHISON CONSOLIDATION have been brought out. A new issue of stock to the amount of $27,000,000 will be made by the Atchison Co. This stock will be exchanged for the St. Louis & San Francisco preferred, and common stock at the rate of one and three-eighths shares of Atchison for one share of St. Louis & San Francisco preferred, and three-fourths of one share of Atchison for one share of common stock. The capital stock of the St. Louis & San Francisco Co. is $30,000,000, of which $10,000,000 is preferred and $15 500,000 is common, the remaining $4,500,000 being first preferred, which is not disturbed. The exchange according to the plan above will leave $714,825 of new stock in the treasury. The comparison of the capital stock of the company before and after consolidation is as follows:

	Capital stock.	Miles of road.	Capital stock, per mile
Before present acquisition.	$75,000,000	67,115.15	$16,540.89
After all exchanges are made for new acquisition	101,285,175	8,993.37	11,256.34

Increase per mile of road.....$755.45, or .07 + per cent.

THE VALVES OF COMPOUND LOCOMOTIVES, says HERR VON BORRIES, in a recent article in the *Organ de Eisenbahnwesens*, should be composed of 82 parts of copper, 14 of tin, 2 of zinc and 2 of antimony. He further states that a compound engine of the old Woolf tandem type, which was tested in France, gave a saving of 12 per cent. in fuel and an increased efficiency over similar simple types. This is the opposite of the results of the Boston and Albany and the North British railway trials.

NOVEL AIR-BRAKES.—Not the least interesting feature of the TRAUTWEILER Jungfrau Railway is the plan for keeping the speed of the cars within prescribed limits during the descent. Folding doors will be placed along the tunnel at short intervals, and will be kept closed except during the passage of a car. These cars have movable wings which may be expanded by the guard until they nearly touch the tunnel lining. In this way the car becomes a kind of piston working in the tunnel as a cylinder, and the air acts as an automatic brake just as in the dash-pots on an old-style Corliss engine. Since the cars are also provided with several brakes of the usual types, it would seem as if the tourist need have little fear of such accidents as usually occur on inclined railways.

AN ELECTRIC RAILWAY TO THE ARCTIC CIRCLE is a scheme projected by a Russian company. The road is to run from St. Petersburg to Archangel, on the White Sea, a distance of about 500 miles. Archangle lies in the latitude of 64° 30', nearly to the Arctic circle. It is proposed to furnish the current by a series of generating stations placed along the route. The cost of the road is estimated at $15,000 per mile.

TOKIO, JAPAN, is to have a cable railway, and Mr. K. NA KAMURA is in Chicago examining the systems there with a view of purchasing a plant for Tokio. He will examine other cities, and has not yet fixed upon any system for adoption. Tokio has about 1,000,000 inhabitants, and a few street cars furnish the only means of transportation.

THE WORST ACCIDENT OF THE WEEK was a crossing collision on the Chicago & Alton road in Kansas City, Mo., May 22, due to culpable recklessness, if press reports are true. An Alton limited train was trying to run ahead of a Missouri Pacific freight train which had the right of way. The freight train struck it near the middle, and one crowded sleeper was completely broken up, with several other cars badly injured. Fortunately only eight passengers were injured, none very seriously. The Alton people attribute this good fortune to their use of the Blackstone coupler. The real cause of the collision seems to have been racing, but this is denied by the Alton engine man, who advanced instead the stale excuse of "air brakes failed to work."

A determined effort to wreck a Baltimore & Ohio train, by tying a good-sized rock, which had been cut in advance to fit the rail, and carefully tied to it, was foiled by the vigilance of a woman station-master.

THE ENGINE WAS TOO HIGH.—Engine No. 871 of the New York Central and Hudson River Road made its first run from Albany this week with the train reaching the Grand Central Station at 3:25 P. M. At Fiftieth Street the smokestack, bell and dome struck the bridge and were smashed by the contact. No. 871 is the heaviest passenger engine on the Hudson River division of the road. It was built at the Schenectady works. It has driving wheels 6 ft. 6 in. in diameter, and weighs 75 tons. So high is the engine that it was found that the dome, even when it was crushed in, came within three inches of the bridge at Fiftieth st., and the roof of the cab missed it by only ten inches.

A CURIOUS ACCIDENT occurred on the Atlantic Coast Line, just beyond Columbia, S. C., at midnight on May 27. There had been heavy rain in the evening, and an embankment was washed away under the track for 20 ft., the rails bridging a washout 10 ft. deep. The northbound passenger train came along at a very high speed. The engine and the forward cars cleared the break without leaving the track; the rails then spread, and the second and first-class passenger cars were hurled down the embankment and broken into splinters. Four men were injured.

A SINGULAR BREAKAWAY occurred to a freight train near Slatington, on the Lehigh Valley R. R., May 27. While ascending a heavy grade it parted at three couplings almost at once. The second and third sections collided, wrecking a number of cars.

The rear section came around a curve a moment later, at a high rate of speed, and dashed into the wreck. Thirty-five loaded freight and coal cars were demolished.

THE JUSTINE DYNAMITE SHELL EXPERIMENT at Perryville, N. Y., on May 27, resulted at the first shot in the complete rupture of the Blakely 9-in. rifle used in the experiment. The shells prepared were 9 in. in diameter and 44 in. long, with an outer shell of 7.16 in. steel enclosing an inner shell which contained giant powder or dynamite in cylindrical wooden boxes. Slow-burning cocoa powder was used as the firing charge in the rifle. The quantity of dynamite in the shell was not made public, but Dr. JUSTINE said it was "less" than that used in the experiment of last March, when the 331-lb. projectile contained 18 lbs. of dynamite and was propelled by 35 lbs. of powder without injury to the gun. Last Tuesday the gun was fired by a fuse, and a tremendous explosion followed, rending the gun into fragments and casting these to considerable distances around. No one was hurt, but there were several narrow escapes. Commander JEWELL, of the Newport Torpedo Station, who was present, said that the steel shell was only partly filled, and the thin steel casing was doubtless broken by the shock of discharge, and the powder flame thus reached and exploded the dynamite. The Blakely rifle was a relic of the late war and was really unfit for service, as the fragments showed the metal to be full of flaws The rifling in the gun showed the breaking of the steel shell casing, which will be made stouter in future experiments.

AN INTERNATIONAL ELECTRICAL EXHIBITION is to be held in Frankfort-o.-M., during the summer of 1891. For all particulars address LEOPOLD SONNEMANN, Chairman, or CARL STIEBEL, Secretary, at Frankfort, Germany.

THE CHICAGO FAIR SITE QUESTION seems to be practically settled in favor of the central lake front site, 253 acres of which has to be filled in. The most serious objection is that it will crowd the down-town streets excessively, the tide of travel corresponding with the regular business travel, and this objection is so very serious that we much question if it should not exclude this site altogether. About 8,500,000 cu. yds. of filling will be required, which can most cheaply be obtained by dredging, the estimated cost of which is 15 to 30 cts. For so great a contract it would seem as if the smaller price should be ample.

THE CHICAGO SITE COMMITTEE advertises formally for "proposals" for a suitable site, as follows:

The committee on grounds and buildings will entertain and consider proposals for a suitable site for said exposition. The ground for such site must embrace an area of 250 acres or more in one unbroken body. Any timber or trees will be subject to removal at the pleasure of the board of directors. The land must be located so that the entire area may be thoroughly subdivided and be within convenient and economical distance of an ample supply of wholesome water for domestic use. The proposed site must be accessible by streets or avenues ample in number, and by public transportation facilities sufficient to convey conveniently and quickly the visitors who rely upon such transportation to visit the exhibition. The nearest point of ground thereto must be at least 1,500 ft. away from any objectionable structures or other features incompatible with the proposed exposition. Parties desiring to submit proposals must report fully and specifically in writing upon all the requirements herein set forth, with such additional propositions as they may desire. The committee reserves the right to reject any or all proposals.

A NOVEL MAP OF THE UNITED STATES is proposed by a Chicago engineer as an exhibit at the coming Fair. The idea is to set inside a proportional area of ground for each State, and to lay out the ground in the shape of the States; near the location of the capital would be erected the official headquarters of that State. On a scale of one mile = 1.518 ft. some of the distances on this "map" would be New York to Philadelphia, 90 miles, or 137 ft.; Chicago to New Orleans, 915 miles, or 1,389 ft.; Chicago to San Francisco, 2,357 miles, or 4,578 ft. The total space required would be about 1.04 miles by 0.28 miles.

PARIS STREET SWEEPING, says *Murray's Magazine*, is performed by 2,600 men and 600 women, who have to begin their work at 4 in the morning, and continue without interruption till 11, when the work for women ceases; the men continue for ten hours, and are paid by the day, from 65 cts. to 74 cts. The women are paid 6 cts. an hour, and cannot earn more than 45 cts. a day, for very hard work; all are obliged to provide their own brooms.

An Experimental Study of Atmospheric Resistance.*

BY O. T. CROSBY.

While making plans for electric train service at very high speeds, it recently became important that I should examine what was known of atmospheric resistance to bodies in motion. Experiments were undertaken with the view of obtaining guidance for the special problem. As in some directions these experiments were of greater range than any similar ones, and as they furnish new values for certain important functions, it seems that they should be publicly reported. The questions presented are:

(A) What are the laws connecting the pressure with variations in relative velocity of air and resisting solid?

(B) What are the laws connecting pressure with variations in (1) density, (2) temperature, (3) humidity of the atmosphere?

(C) What are the laws connecting pressure with variations in (1) size, (2) shape, and (3) angle of incidence of the resisting solid?

(D) What are the constants which, supposing knowledge of the laws of variation, permit solution of a particular case?

(E) What is the relation between pressure of the atmosphere against a rigid body in motion, and that of atmosphere in motion against a rigid body fixed in space?

The experiments to be here set forth, made by Mr. B. J. DASHIELL, Jr., M. E., and myself, give direct information concerning questions (A), (B), (C) and (D); concerning (E), inference of less certain value is had.

Before detailing the experiments, I will collate some of the authorities on the subject, that their embarrassingly variant positions may be appreciated, and the relative value of the new matter better understood.

BASHFORTH, a high English authority in ordnance work, concluded that between the velocities 100 and 500 ft. per second, P varies as V^2; between 900 and 1,100 ft. per second, P varies as V^3; between 1,100 and 1,350 ft. p. s., P varies as V^3; beyond that velocity, P varies as V^2. It is, of course, understood that changes of function are not as abrupt as given for convenience in this scale.

MAYCOSKI, an equally high Continental authority, introduces, in his formula, the square as the function throughout practical velocities.

The great majority of those who have worked in this matter and at the lower velocities have assumed without question that the square of velocity is the only form of the function to be considered. Their experiments have not covered wide ranges of velocities, and in some cases—notably in that of HAGEN, generally referred to as one of the best authorities—the actual recorded experiments were far from sufficient to establish the velocity variation.

Whether the true law of velocity variation may not be connected with area variation is a not unreasonable inquiry, but one to which at present no answer can be given.

It is, perhaps, needless to say that a rough exterior offers more resistance than a relatively smooth one. Assuming the body to be of ordinarily smooth exterior and free from longitudinal irregularities of shape, we then have little evidence as to variation of resistance depending upon a variation in shape of perimeter alone, as from a circle to a triangle.

As to angle of incidence, a good deal of experiment has been made, the matter being of prime importance in both civil and military engineering.

Prof. UNWIN, adopting the formula,

$$R = P\frac{2\cos^2\psi}{1 + \cos^2\psi}$$

(in which R = pressure in direction of motion, and P is equal to pressure on the surface when normal to line of motion) finds for the total (normal) pressure on the surface:

$$N = \frac{2P}{\sec\psi + \cos\psi}$$

Hemispherical and cylindrical fronts are usually said to offer one-half the resistance against their respective bases.

BORDA is quoted as saying: "Balls (spherical probably) give only 0.36 to 0.41, and elongated projectiles less than half these values." As to the ratio between spherical and ogeeval headed shot, the ordnance officers, United States Army, determined the constants .000514 and .000385 for the two cases respectively, these constants entering into DIDION'S formula for projectile resistances. BASHFORTH gives the following ratios:

Hemispherical	1.
Hemispheroidal	0.78
Ogeeval head (one diameter)	0.83
" " (two diameters)	0.78
Flat head	1.53

He further states that the resistance is greatly affected by the slope of the surface joining head and body; this slope should be as gentle as possible.

It may be noted, though not strictly under this head, that a few efforts have been made to determine the effect of change in the shape of the rear end of a moving body, but they have usually been complicated by connection with change in length of the body, and nothing clear on the subject is known. HUTTON states that he could determine no appreciable difference of pressure for variations in shape of rear.

(TO BE CONTINUED.)

* Abstract of paper read before West Point branch of the Military Service Institute, April 17, 1890.

The New Pumping Engines, Chicago, Ill.

(WITH INSET.)

The inset in this issue shows one of the new Harrison St. pumping engines for the water supply of Chicago, Ill. It was built by the Edward P. Allis Co., of Milwaukee, Wis., and is represented as set up in their shop for testing, without the jacketing, etc., to be applied when in its proper place.

The principle dimensions of these pumping engines may be given as follows: High-pressure cylinder, 27 ins. diameter; intermediate cylinder, 46 ins.; low-pressure, 70 ins., and all 60 ins. stroke. Each engine is designed to lift 15,000,000 galls. of water 125 ft. in 24 hours. The Milwaukee company is building five engines of this type and capacity.

Some of the chief features of this engine may be described as follows: The plungers are solidly connected to the cross-heads by distance rods so that all the power required to move the pump-plungers is transmitted directly from the piston-heads without the interposition of links or joints of any kind. All the steam cylinders are thoroughly jacketed, and the cut-offs of each cylinder are so arranged that they are handled and adjusted from the engine room floor by means of hand wheels and levers; the expansion in each cylinder is thus easily adjusted to suit circumstances.

The pump-valves are made of hard rubber, mounted on cages having brass valve-seats and keepers. The cranks are set 120° apart; Reynolds-Corliss automatic valve gear is used on all the cylinders, and the engines weigh 450 tons each.

Two of these engines are now erected in the Harrison St. pumping Station, and are only awaiting connection with mains to go into service. The city is to make the connection. The other three, of a similar type and capacity, will be erected at the Indiana St. pumping station as soon as the foundations and buildings are completed.

Stone Arch at Elyria, Ohio.

The fine stone arch which we illustrate, almost if not quite the boldest arch of its span in the world, and probably the second largest arch in the United States, was erected in 1886 but owing to the reprehensible negligence or modesty of its designing and constructing engineer Mr. E. C. KINNEY, M. Am. Soc. C. E., now Assistant Chief Engineer Union Pacific Railway, it has only come to our knowledge, and through us to scientific record, in 1890. That it well deserves such record the following figures show. That it is of graceful as well as bold design, the engraving shows at once.

The arch has a clear span of 150 ft. with a rise from spring line to key stone of 27 ft. The stone was a fine quality of Amherst sandstone, and workmanship throughout first-class, as will be seen. The depth of the arch stone at the springing line is 4 ft. 6 in.; at key stone, 3 ft. 9 in.; middle of bridge, 32 ft. over all. Mr. KINNEY states in a note to the editor, "I have not heard of a longer span in the United States except the Cabin John arch. If you know of a longer one I should be pleased to hear of it."

We are unable to give a reference to any larger span than this now existing on this continent, and, therefore, infer that it is the second largest, although this inference may be incorrect. It ranks well up among the great spans of the world, however. In

"Trautwine's Pocket-Book" there are but three others listed as of greater span in any part of the world, but that list does not pretend to be exhaustive. These structures compare as follows in their main dimensions:

	Span. ft.	Rise. ft.	Radius. ft.	Key. ft.	Engineer.
Cabin John, Washington Aqueduct..	220	57¼	134¼	4′ 2″	Meigs.
Grosvenor Bridge, Chester, Eng.....	200	42	140	4′ 0″	Hartley.
London Bridge, Eng.	152	29½	112.6	4′ 9″	Rennie.
Severn Bridge, Gloucester, Eng.....	150	35	98	4′ 6″	Telford.
Elyria, O., bridge...	150	27	208⅓	3′ 9″	Kinney.
Dora Riparia, Turin, Italy.....	148	18	160.1	4′ 11′	

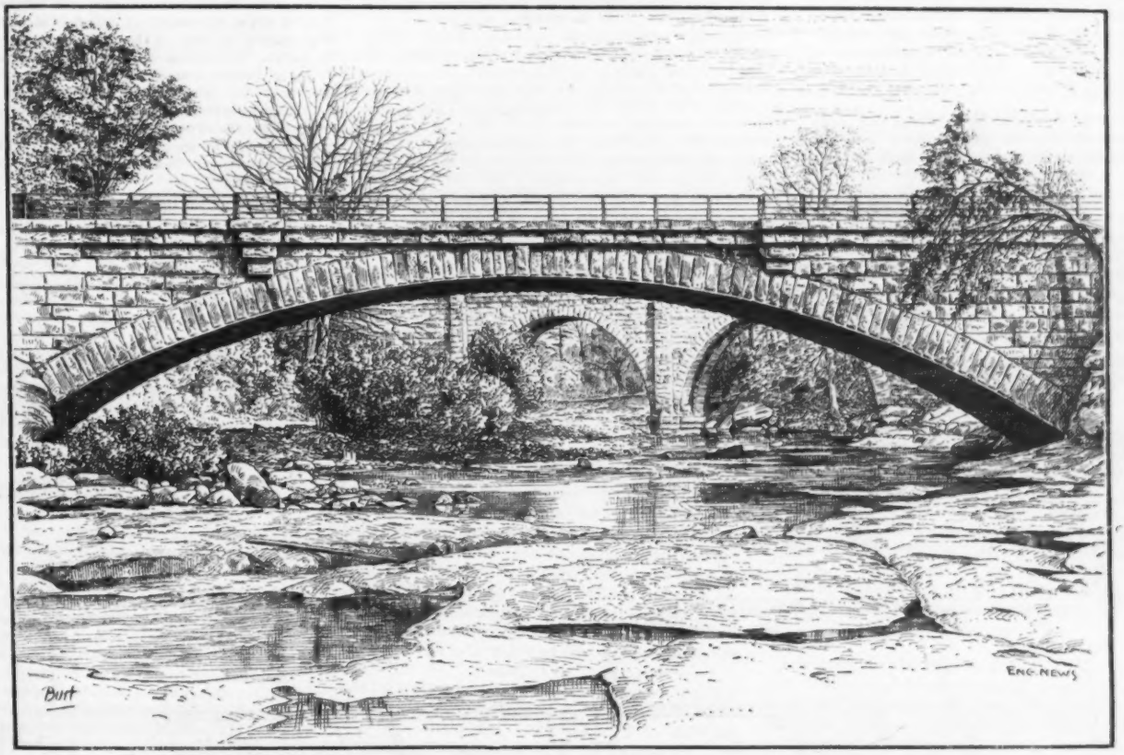
The first two and the last two of these arches are segmental circular arches, the two intermediate arches elliptical, or many-centered.

The boldness of the structure will be at once apparent from this list. It will be better seen by comparison of the actual keys of these arches with those given by TRAUTWINE'S rule:

	Actual key. ft. in.	Key to Trautwine ft. in.	Diff. in.
Cabin John.....	4 2	4 1⅜	+ 0⅝
Grosvenor.....	4 0	4 1	− 1
London.....	4 9	3 7¼	+ 13½
Severn.....	4 6	3 6	+ 12
Elyria.....	3 9	4 7	− 14
Dora Riparia.....	4 11	4 0⅝	+ 10⅝

It will be seen that the Elyria arch has a key notably less than TRAUTWINE'S rule calls for, while all the others of its span have very much more.

The beauty of the arch in our view is much enhanced by the second stone bridge in the distance, which we believe is one of the many structures of the kind which have been erected on the Lake Shore & Michigan Southern Ry. in recent years. Northern Ohio, in fact, is beginning to have a great many fine stone arches, but certainly there is none finer there or anywhere than the one we illustrate, which, to our thinking, is far more graceful and effective for being left with the natural rock face, although the taste of an earlier age required all such structures to be dressed.



Stone Arch for Highway at Elyria, O.—E. C. KINNEY, M. Am. Soc. C. E., *Engineer.*

The Public Works Controversy in Providence.

The Board of Trade of Providence, R. I., representing citizens who pay a large portion of the taxes of that city, vigorously protest against the late action of the State Legislature in its uncalled-for interference with the conduct of municipal affairs. The protest was made on impersonal and non-political grounds, but as purely in the interest of self-government by the city in affairs which concerned it alone, and for the control of work for which the taxpayers of Providence alone contributed.

The resolution, which was unanimously passed, recited, in brief, that the passage of this act seriously abridged the power of the City Council of Providence to control and regulate the engineering department of that city; that it summarily forced from his position a principal officer of that city, unanimously elected by the Councils within less than five months, and this without the lodgment of specific charges against him, and that this same Legislature had previously forced upon the city a Secretary to the Commissioner of Public Works, at a salary of $3,000, after the Council had decided that $2,500 was too much for the successor to a man who was paid only $1,500 per annum. The board viewed with astonishment and serious concern these efforts of the Legislature to regulate the affairs of the City of Providence, and, as representing the taxpayers of the city, it emphatically and respectfully protested against this appropriation of the money of the taxpayers of Providence by the State Legislature.

In seconding the resolutions, Ex-Governor LIPPITT strongly put the case of the city in this controversy and stated in the beginning that he was not so much interested in the men and the political consequences as in the deed itself, as a total subversion of municipal authority. The fight practically commenced between two factions in the City Council, one favoring the engineering department as it had existed for 18 or 20 years, and the other in favor of one-man power as represented in a Commissioner of Public Works invested with sole control. This faction fight has almost paralyzed the City Council for two years, or since the present Commissioner was elected, and great public works have been correspondingly delayed.

Gov. LIPPITT contended that it was un-American and anti-republican to brush aside fifty men on the charge of incompetency and to vest the absolute power in one man, with a fixed tenure of three years, and who can not be turned out or hampered in the discharge of his functions. It was really of no avail for this Commissioner's friends to say that he could only spend money when the Councils appropriated it, for the Councils must appropriate money for highways, sewers, bridges, etc., or allow all the interests of the city to be sacrificed. The present law vests the appointment of the City Engineer and all his assistants, to any number he may deem fit, in the Commissioner, and this officer also defines the duties of these engineers; though the Board of Aldermen can approve or disapprove of the salaries and the term of office named. Of the $1,800,000 annually collected in taxes, this commissioner will control the expenditure of more than all the other departments combined. In concluding, Gov. LIPPITT intimated that as Providence represented nearly one-half of the entire voting population of the State, the matter could be adjusted by electing to the next Legislature and the next City Councils men who would not misrepresent the interests of the city. The resolutions of the Board were carried unanimously.

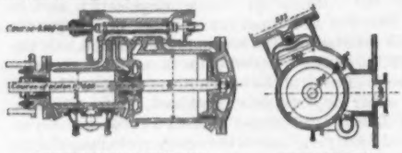
The Mekarski Compressed-Air Tramway Motor.

(*Continued.*)

The air, being heated and saturated, to pass to the cylinders goes through an orifice of the lower chamber of the regulator in which a conical valve plays. This valve is arranged in such a way that it closes by the effect of the pressure of the air in the heater. It only opens when a pressure is made on its upper face acting on the diaphragm of the little hydraulic press. It is seen that the first effect of the pressure in the hydraulic press is to open the valve and admit air. As soon as the pressure in the lower chamber gets to be as great as that in the upper, the pressures on the two sides of the diaphragm being equal, the valve closes by the pressure from below. This common pressure, which can be so easily regulated, is the pressure fed to the cylinders. This pressure, which remains automatically constant as long as the wheel moving the press is untouched, can be varied at will.

The air now passes to the cylinders, which are arranged in sets of two, each pair forming a tandem double expansion engine. The two cylinders of a set are of different diameters and are cast in one piece. The rod of the two pistons passes through the cylinder head in a spring metallic stuffing-box. The air is admitted to both cylinders in succession by the means of the same compound slide-valve. The admission to the smaller cylinder is cut off at about two-thirds the stroke. This air is now passed into the larger cylinder, whose volume is four times larger than the first. The total proportion of expansion, therefore, is about 6 volumes. Such an expansion cannot be produced with the steam in locomotives, especially where great promptitude in starting is required. Both factors governing the tractive power can be changed—the cut-off, and the pressure of air—and consequently this system is one that can be most perfectly controlled. Since, however

rom this large expansion it might result that with an initial pressure and cut-off the expansion would be to a pressure less than 1 atmosphere, and a negative work would ensue, there has been placed at the lower part of the cylinder an air-valve allowing outside air to enter in such an emergency.



LONGITUDINAL SECTION. CROSS SECTION.

Figs. 3 and 4.—Sections of Cylinder.

Figs. 3, 4 show a cylinder rather larger than the one in use on this tram-way, designed for a full-sized locomotive. It, however, shows the proper proportion and arrangement of the parts. The speed, so easily varied, can be made as much as 65 kilos. (40 miles) an hour if necessary. The legal limit of speed on the tram-way is 20 kilos (12½ miles).

The arrangement of the machine, in which the space inside the wheels and under the car is entirely taken up by the reservoirs, obliges the cylinders and their dependent parts to be placed outside. Their protection, however, is insured by a sheet-iron boxing, which, with its closed doors, conceals every thing under the car. In order that no difficulty in cold weather from the collecting and freezing of the moisture in the air may take place, the air is led from the exhaust valves of the cylinder by a pipe out of the box and under the car. So far the coldest weather has not had any disagreeable result in any part of the machinery.

The engineer is placed on the front platform of the tram, which is railed off from the public, and manages the regulator. Two manometers are placed on top of the heater, and indicate the pressures in the battery and the reserve. A third manometer gives him the pressure in the regulator and the cylinders. All the motions of manœuvering the machine are extremely simple: there is a lever to change the action of the slide-valve, thus giving more or less cut-off or changing the direction of the motion; there is a lever to apply the air-brakes; another to cut off the supply of air to the cylinders, and a small cylinder in which, when the piston is pressed down, the escaping air sounds a horn.

The two pairs of wheels are coupled by a connecting rod; thus both act as drivers, and the whole weight of the car is made use of in propelling itself. The axles being only 1.6 meters (5 ft. 3¼ ins.) apart, they allow the car to go around the shortest curves without difficulty.

The tram, when charged with air, could make on an ordinary grading a run of over 20 kilos. (12⅜ miles) without recharging, but on this track only 14 kilos. (9 miles) can be made, on account of the heavy grades and the unusual obstructions in the way of dirt, etc. The mean consumption of air on this line is about 10 kilos. per kilo. (35 lbs. per mile) where the grade is the heaviest; where the grade is only 0.02 only 7 kilos. per kilo. (24 lbs. per mile) are necessary.

The machinery and apparatus for compressing the air is in two sections at two different stations, the larger at La Maltournée, and the other at Vincennes. The station at La Maltournée has—

Two tubular boilers of 60 meters (653½ sq. ft.) heating surface apiece in the boiler house.

In the engine room, four 35 horse-power steam-engines, each working a large air compressor.

A reservoir room containing twelve reservoirs of air at 45 atmospheres of 1,250 liters (330.2 galls.) capacity and intended to contain the air compressed by the pumps in the intervals between the charging of the cars.

Reservoirs of water and a feeding pump for the boilers.

A workshop containing an engine, lathes, punching machines, blacksmith's shop, etc.

An electric dynamo (Gerard) for incandescent lighting.

A charging room for the tram-cars.

Stables for the rolling stock.

Offices for employés, ticket office, waiting-room, etc.

Coal yards and yards for road materials.

The operation of charging the tram reservoirs is made in a special room called the charging-room. The reservoirs should hold, before the start, 3,106 liters of air, and the heater 200 liters of water at a temperature of 155° C. The air and the steam which heats the water are brought to the charging-room by pipes—copper for the steam and iron for the air. These pipes end in orifices provided with screw cocks. The water in the heater is heated by passing the steam from the steam-pipe through it, and it is only refilled with water when the heater is emptied for repairs. For the operation of charging, the cars are brought opposite the cocks, and by means of connecting pipes the cocks are put in connection with corresponding cocks in the car. The duration of charging is about fifteen minutes.

It has been found possible, however, in the case of prolonged runs, to have air pipes brought to the side of the track, and a partial refilling of the reservoirs effected while tickets are being taken, etc.; this takes only about three minutes.

There are two parts of the Nogentais tramway that might be called the main line and the branch; main line, 9,580 meters (31,432 ft.); branch line, 2,108 meters (9,916 ft.); total length, 11,688 meters (38,348 ft.)

On this line the track varies in its position; 6,550 meters (21,290 ft.) placed on the sidewalk and 5,138 meters (17,060 ft.) placed in the road or carriage way. The gauge, which is standard (4 ft. 8½ ins.), is increased by one-fourth of an inch on curves. The track set in the sidewalk is made of Vignolles or T-rails of 8 meters length and weighing 20.1875 kilos. the running meter (40 lbs. per yard), placed on oak ties of 2.2 × 0.14 × 0.1 meters (6 ft. 3 ins. × 5½ ins. × 4 ins.) dimensions, set apart 0.875 meter (34 ins.), center to center. These ties are cut in such a way as to give a cant to the rail of 1 in 20. The rails are fastened to the ties by iron screw spikes, and are joined to each other by ordinary fish-plates and four bolts with Trover nut-locks. The fishing of the rails is made over bridge joints, the ties being at this point 0.5 meter 20 ins.) apart, center to center. The joints are not opposite each other, one being 0.5 meter (20 ins.) in advance of the other. The ballast here is 0.35 to 0.4 meter (14 to 16 ins. thick; 0.15 to 0·2 meter (5 to 7 ins.) of this is underneath the ties.

The part of the track placed in the road is of a different pattern. It is made of rails and flange-guards of steel 8 meters (26 ft. 3 ins.) long, which are exactly similar in section, and in each of which one side of the flange is narrower than the other. These weigh 17.925 kilos. the running meter (36⅛ lbs. per yard), and are joined by fish-plates. The rails and flange-guards are separated by a groove of 0.029 meter (1⅛ ins.) on tangents and 0.035 meter (1⅜ ins.) on curves. They are supported and held together on cast-iron chairs by bolts. These chairs are 0.25 meter (10 ins.) high, and their heads form jaws in which the foot of the rail is held at the proper angle of 1:20. The chairs in their turn are fastened by iron screw spikes on oak ties of the same dimensions as before, set, however, 1 meter (40 ins.), center to center. A number of cast-iron cross-bars, holding the foot of the rail, assure the firmness of the gauge. The fishing of the rail joints and the joints of the flange-guards is made between the ties, as in the other system, the ties being brought to within half a meter (20 ins.) for the purpose. The joint of the first rail is half a meter (20 ins.) in advance of that of the second, and the joint of the first flange-guard is opposite that of the second rail, and *vice versa*. These ties rest on a bed of ballast 0.05 to 0.15 meter (2 to 5 ins.) thick, and this ballast is leveled up to the top of the ties.

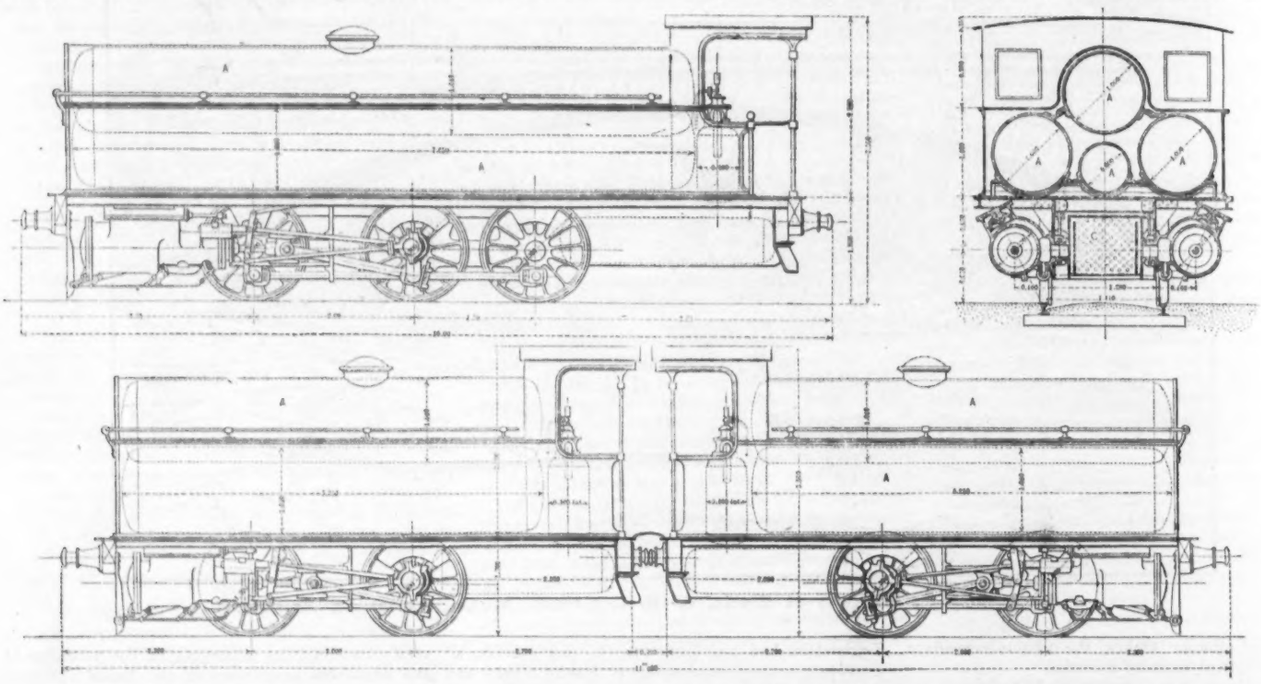


Fig. 5.—Forty and Fifty-ton Locomotives on the Compressed-Air System, designed by M. Mekarski for the City of Paris.

The track in the road is almost all paved; the height of the chairs allows a bed of sand 5 to 9 centimeters (2 to 3 ins.) deep to be placed between the lower surface of the paving stones, which are 0.2 meter (7 ins.) deep, and the top of the ties. Over a length of 560 meters (626 yds.) of this part of the track the rails are set in chairs 0.138 meter (5½ ins.) high and 0.14 × 0.2 meter (5½ × 8 ins.) base, weighing 9¼ kilos. (20½ lbs.) and resting on a bed of concrete of 0.15 meter (5 ins.) thick. This is paved with stones set in Portland cement. In this portion this special form was used on account of the shallow space allowed in crossing bridges, etc. Side tracks are established at various points to allow of passing of the trams going in opposite directions. The minimum distance apart in this case of the two tracks is 1½ meters (5 ft.), allowing a clear separation of the two cars of 0.6 meter (2 ft.)

The switches (Delettrez system) are automatic, allowing the car going towards the switch only to take the right hand track, but by a spring the car, either on the side track or the main line, always keeps to the rails, moving the tongue of the frog. There are turn-tables at intervals, by which the car can be turned 90° or 180° by hand. Their diameter is 2.8 meters (9 ft.)

The following is an approximate estimate of the cost of the different types of track:

(*a*) Vignolles rails on the side track: Cost per meter, 20.53 francs ($4.11); cost per yd., $3.70.

(*b*) Vignolles rails, with special curbstone and sidewalks: Cost per meter, 29.87 francs ($5.98); cost per yard, $5.40.

(*c*) Track on the road paved between the rails and half a meter each side: Cost per meter, 62.54 francs ($12.51); cost per yard, $11.27.

(d) Track on the already paved road: Cost per meter: 35.23 francs ($6.65); cost per yard, $6.

(e) Track on macadamized road: Cost per meter, 35.68 francs ($7.15); cost per yard, $6.44.

(f) Track on a bed of concrete 15 meters thick, with paving set in Portland cement: Cost per meter, 69.02 francs ($13.81); cost per yard, $12.44.

Of course, in these figures account has only been taken of the cost of the track proper and of the prices of materials and of labor. Some other expenses regarding the locality have not been taken account of, such as a payment of $6,400 for bridge restoration, costs of grading and straightening roads, moving gas and water pipes, moving trees in the Bois de Vincennes, etc. These extra expenses added more than a fifth to the regular cost of the road.

In a supplemental report Mr. RATHBONE speaks of the application of this system to locomotives, as illustrated in Fig. 5. This engine was designed for use on a metropolitan railway, either in a tunnel or elevated, where steam would be objectionable. He says:

M. Mékarski shows that with a charged pressure of 50 atmospheres air locomotives might be constructed of an external form similar somewhat to steam locomotives, without tenders or smoke stacks. The air reservoirs occupy on the frame the place of the boiler, without obstructing the engineer's view. He has designed, with this idea, the two types of locomotive given in the plate, showing the side elevations of each and a transverse section. The first type in working order weighs 40,000 kilos. (44 tons). It carries three large cylinders charged each with compressed air. The second model is composed of two smaller carriages coupled back to back like a locomotive to its tender. The two form a locomotive of 50,000 kilos (55 tons).

The 55-ton locomotive is designed with a view to develop a tractive power of 6,000 kilograms (13,228 lbs.) and to run around curves of 150 meters (492 ft.). It is composed of two separate machines mounted on two coupled pairs of driving-wheels each. The reservoirs of compressed air are mounted on the two trucks, which are so arranged that a central cab, where the engineer is placed, is formed by the joined ends. The view from this cab is in no way obstructed by the reservoirs in either direction, and they are entirely hidden under a covering of sheet-iron.

The total length of the truck from end to end, including the buffers, is 14.4 meters (47 ft. 3 ins.); the greatest width is 3.2 meters (10 ft. 6 ins.), and greatest height above rails 1.3 meters) 4 ft. 3 ins. The diameters of the cylinders are, respectively, 0.26 meter (10¼ ins.) and 0.5 meter (19⅝ ins.); the common stroke is half a meter (20 ins.) Each of the four reservoirs is 5.2 meters (17 ft. 1 in.) long. Three of them have an internal diameter of one meter (39⅜ ins.); the fourth, smaller, is only 0.6 meter (23⅝ ins.) in diameter. The reservoirs are made of soft steel, 20 millimeters (¾in.) thick for the large, and 12 millimeters (½ in.) for the smaller one. The total capacity of one battery is 13 cubic meters (460 cu. ft); the weight of air compressed in them would be 800 kilograms (1,764 lbs.), or a total of 1,600 kilos. (3,528 lbs.) Each battery weighs about 10,500 kilos. 11½ tons).

There is a heater and a regulator on each part of the locomotive, but they are so arranged that by maneuvering one of them all the cylinders of both machines will be similarly affected. Besides the hot water in the two heaters proper, there is an extra supply of hot water in two reservoirs under each part of the cab—four reservoirs in all which communicate with the heaters. The total capacity of hot water in each machine would, therefore, be 1,000 kilos. (2,205 lbs.)

The air in this machine, after being used, passes through an arrangement which might be called a condenser. This is used in order that no moisture, even in minute quantities, might be deposited in the tunnels. It acts simply to connect the moisture in the exhaust air, and is in form similar to a tubular condenser for a steam engine.

There is little to be said of the 44 ton machine, after having the preceding description, since it has very much the same characteristics. It is formed of a single frame mounted on three pairs of driving-wheels, all coupled. The reservoirs are of the same diameter as in the 55-ton type, and are similarly placed, only varying in their length. It might be added that, no fireman being needed for these locomotives, a great saving in wages is effected, but this is nearly made up for in the extra labor, capital, and wear incurred in having the extra stationary plant.

Mr. H. A. SHACKELFORD, Consul at Nantes, adds as follows concerning the operations of the line in that city: The maximum grades in the line in Nantes are about 25 ft. per mile, but present no difficulties in operation. The cars used are clumsy and weigh twice as much as American cars. The cost of running a car, for a daily run of 60 miles, is as follows:—for coal and oil, $1.20; wages for operator and conductor (New York prices) $3 to $3.50; repairs to cars, $1.80; total $6.50 per day, or 10 to 11 cts. per mile.

Plans for the Sewerage of Orange, N. J.

Preliminary plans for the sewerage and drainage of Orange, N. J., were presented to the Town Council on May 13, by Mr. CARROLL PH. BASSETT, C. E. of Newark, N. J. The accompanying report dealt in detail with the problem presented and its inherent difficulties. Briefly stated, the plans provide for the treatment of an area of 1,400 acres lying from 200 to 272 ft. above the tide-water. The present population is about 19,000; but the sewer capacity has been designed for 60,000, the estimated population in 40 years. The disposal of sewage and storm water is separated in the plans, to save in areas of sewers and also because much, if not all, of the sewage must be pumped.

The estimated cost of house sewers, from 8 ins. to 24 ins. in diameter, is $220,017 for a total length of 35.3 miles. Land, pumping station, vault pumps, etc., and 2,000 ft. of force main, would add $13,000. With engineering, inspection and incidentals figured at 10 per cent. the total cost of disposal into the Passaic River would be $256,318.

To dispose of the sewage into Newark Bay, the house sewers would cost $217,323; and two sets of pumping stations and forcing mains, with engineering, etc., as before, would raise the total cost to $292,301. All of these sewers need not be built at once, and 5.3 miles may be deducted from the estimates, leaving $228,334 as the cost of the Passaic outlet, and $264,317 for the Newark Bay outlet. The outlets to the house-sewer system are estimated as follows:—Passaic River outlet, 24,730 ft. of 24 in. pipe, tidal chamber, engineering, etc., $105,838. Newark Bay outlet, 47,255 ft. of 24 in. pipe, engineering, etc., $155,941. Aside from the excess of cost, the Newark Bay outlet would cross 2½ miles of level meadow in which the pipe would be difficult to keep clean unless it were laid partly on embankment.

The Passaic outlet would be over one half mile below the Jersey City water-works and over 1½ miles below the Newark intake. Though the sewage of Newark itself would be much more likely to pollute the water supply than the sewage of Orange, yet, to reduce the cause for complaint, Mr. BASSETT has designed a plan for a receiving vault located on the outlet line, near Passaic, with a capacity for a 12-hour flow of sewage. By this arrangement the sewage would only be discharged on the first half hour after high tide and thus pass at once down the river.

The disposal of the storm-water in the town requires sewers from 4 ft. to 10 ft. diameter, and the total cost of the completed system would be $275,734, though only $149,495 need be at once expended. The summary of the entire work needed for immediate construction is given as follows:

Thirty miles of street sewers	$228,334.98
Passaic outlet and tidal chamber	105,838.70
Storm water system	149,495 00
Total	$483,668.68

The scheme is now being considered by the councils and citizens of Orange. The consent by petition of three-fourths of the property owners is required before councils can act.

Public Works in Siam.

From a very interesting letter received from Mr. ROBERT GORDON, M. Inst., C. E., Government Engineer of Siam, under date of April 8, we make the following extracts relating to proposed public works in that country:

A railway survey is now being made from Bangkok to Khorat, a distance of 195 miles, of which 40 miles is through hills rising 1,200 ft. and descending again to 800 ft. in the Khorat plain. This plain is completely shut out from commerce, except by bullock paths, by a range of hills running N. by S. to about the latitude of Bangkok, where it turns east and west to beyond the Nukhong river. The plain is 250 miles square and lies from 400 to 800 ft. above sea-level; it is marvellously fertile and the bounding ranges are excessively rich in minerals, lead, copper and silver being especially abundant. It is peopled by a quiet, industrious race, called Laos; but as before mentioned is shut off from all profitable traffic.

The Siamese Government is anxious to have this railway built; but everything in this line is new to the people, and the authorities hesitate to act. The surveys, however, will be completed by July next, when something may be done at once. It is the most important railway for the development of Siam.

About 1,200 miles of other railways are contemplated, and about 700 miles are being surveyed. The Patren line, mentioned in the papers, has been postponed owing to a disagreement on terms of the concession. The Siamese are now all in favor of the American system of rolling stock, and rules and regulations are being now drawn up to fix this. But nothing is yet settled, and the English contractors may yet persuade the Government to adopt smaller rolling stock.

Siam is a wonderful country; but, excepting a semblance of civilization at Bangkok, is utterly behind hand in all manner of public improvements. The interior can only be developed by a system of railways and highways, for the rivers are only navigable for short distances from the coast-line When the start is made, says Mr. GORDON, the progress will probably be rapid as the ruling power is enlightened, but is now cautiously feeling its way.

Mr. GORDON is planning a water supply for Bangkok. The supply will be taken 12 miles off, in a straight line, from the Meh-ham river, and depositing tanks, fillers, etc., will be required. It is proposed to erect engines at the river to pump into a 120 ft. stand-pipe, with another set of engines, a stand-pipe and filter-beds in the city. Worthington high-pressure engines, in pairs, at each place, and a 3 ft. main are contemplated. The supply required is 12 to 18 million gallons daily. The use of a new quick running pumping engine, made by Simpson & Co., of London, may modify these plans to the extent of putting a higher stand-pipe at the upper end only, with filter beds, etc., at the same point.

The necessity for sending some miles of hydraulic welded or riveted steel tubing, 7 to 22 ins. diam., to the Burmah Ruby Mines, has induced Mr. GORDON to invent a new pipe-joint, for which patents are now pending. The freight on this Burmese pipe was $20 to $30 per ton, and the pipe was charged according to outside measurement of flanges. Mr. GORDON has devised a plan for shipping the pipe and flange separately, according to a method which he hopes to illustrate at the proper time.

THE FIRST CABLE to cross the gulf stream will be the Halifax and Bermuda cable, now on its way to be laid. The cable is 874 miles in length and weighs 2,061 tons. When the shore ends have been fixed telegraphic communication will be established between Halifax and Bermuda, which may form the basis of subsequent developments. The British Government has granted a subsidy of £8,100 to the company. It is expected that communication will be established by June 24.

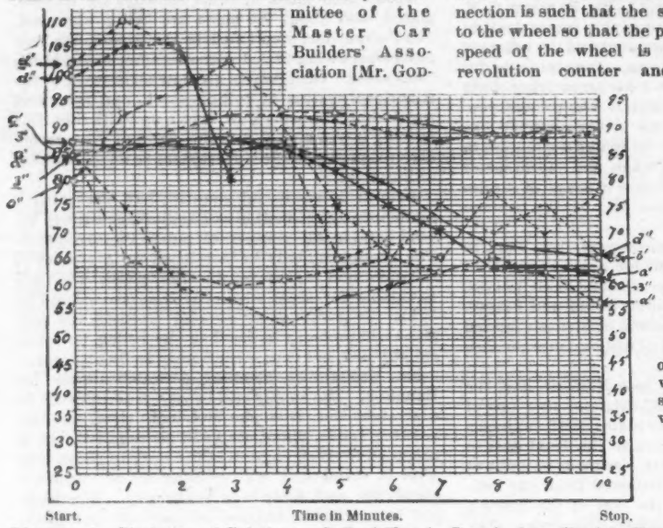
A NEW ALUMINUM PROCESS, says the Atlanta *Constitution*, has been patented by Mr. SAMUEL W. GOODE of that city. According to the statements of the inventor—to be liberally discounted—he can produce this new metal at a cost of "less than $1 per pound." A stock company is being talked of with a plant at Atlanta, Ga.

A TESTING MACHINE, just completed by the Phœnix Iron Co., of Phœnixville, Pa., is said to be the largest ever built. It is designed to test full size bridge members up to 55 ft. in length and to strains up to 2,000,000 lbs. either in tension or compression. Water pressure of 720 lbs. per sq. in. is applied to a cylinder 5 ft. 6 ins. in diameter and 5 ft. stroke. The general style of construction is similar to the machine at the Union Bridge Works at Athens, Pa. The cylinder is cast steel, and without the heads weighs 28,000 lbs.; the other parts, cross-heads, etc., are correspondingly massive. All castings were made by the Chester Steel Co., of Chester, Pa., while the rest of the work was done in the shops of the Phœnix Co.

THE TIDE TABLES FOR THE ATLANTIC COAST OF THE UNITED STATES, together with 206 stations on the Atlantic coast of British America, for the year 1891, published by the U. S. Coast and Geodetic Survey, are now ready for issue, and copies can be obtained at the agencies of the survey in New York, or by addressing the office at Washington. Price twenty-five cents.

Brake-Shoe Tests and Testing Machine.

As a part of the proposed tests of various kinds of brake-shoes which have been undertaken by a committee of the Master Car Builders' Association [Mr. GODFREY W. RHODES, Chairman], as announced in our issue of Jan. 25, 1890, and reviewed in our issue of May 17, the machine illustrated herewith has been devised for shop tests of various shoes, and a few of the results of the tests so far made are shown in the accompanying diagrams.



This diagram is for FOUR only of the TEN kinds of shoes whose average results are shown on Diagrams B and C., viz.:

a is for No. 9
b is for No. 7
c is for No. 2
d is for No. 5

Diagram A.—Variation of Friction or Pull of Shoe in Pounds from Start to Stop for Runs of Ten Minutes.

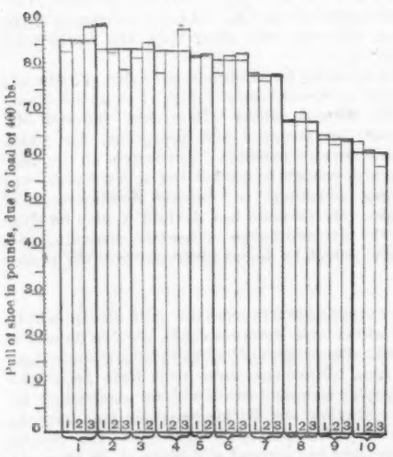


Diagram B.—Comparative Friction or Pull of Shoe in Pounds Due to a Load of 400 lbs.

[For ten different kinds of brake shoes.]

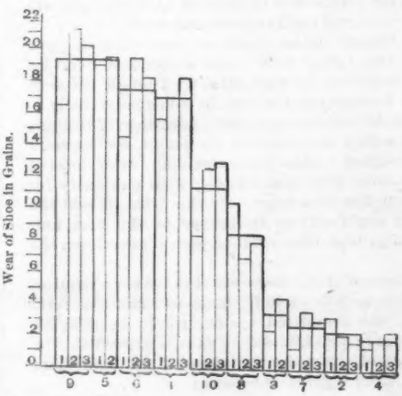
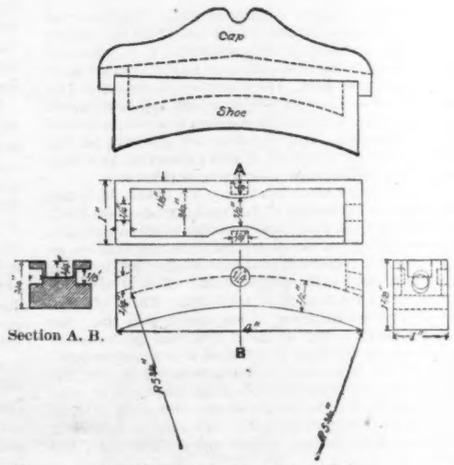


Diagram C.—Comparative Wear or Loss of Weight in Grains During Tests Shown in Diagrams A and B.



Experimental Brake Shoe and Cap.

[Load on Shoe, 400 lbs., on 4 sq. ins. Wheel, chilled cast iron 11 7-16 in. diameter. Speed, 600 revs. per minute = 20 miles per hour.]

Results of Preliminary Shop Tests of the Friction Pull, and Variations Therein, and Loss of Weight of Brake Shoes of Ten Different Kinds. Chicago, Burlington & Quincy Railroad.

[No. 1 is a soft cast-iron shoe; No. 4, a wrought-iron shoe. The materials of the remaining shoes are not at present announced.]

The engraving herewith shows the machine complete, ready for a test. The main body of the machine is that of a "Thurston Oil Tester," from which the journal sleeve and pendulum attachments have been removed, and a wheel on which the shoes are tested keyed on to the shaft. The shoe rests on the wheel directly above the centre of the shaft.

The load is brought on the shoe by means of the lever shown. A few turns of the hand-wheel draw the lever down and bring up the scale beam which has been set to give the required weight on the shoe, due allowance having been made for weight of parts. The load lever is so connected by means of the link at the fulcrum that the shoe and lever are free to move with the wheel, so far as the loading arrangement is concerned. This tendency to move forward is weighed by an independent arrangement, and the force necessary to hold the shoe in its proper place is weighed by the second scale beam, termed the "friction scale." This is connected to the shoe by means of the levers shown, the link at the end of the bell-crank lever coupling into a yoke which is fastened to the shoe at its middle on each side. This connection is such that the shoe is free to adapt itself to the wheel so that the pull is always direct. The speed of the wheel is obtained by reading the revolution counter and timing with a shop watch. These are shown at the rear of the machine.

In making a test the machine is started light, and the hand wheel is turned until the scale beam rises. The observer then seats himself opposite the friction scale beam, and by moving the sliding weight keeps the scale beam balanced, recording at one minute intervals the weight, and at two minute intervals the speed, for a period of ten minutes. Thus, in each test there are ten observations of the friction, each of which is an average, and five observations as to speed. The shoe is accurately weighed before and after test, to show the wear. Observations to date have indicated no appreciable wear in the chilled iron wheel. No tests have yet been made on steel tires. The construction of the test shoe is such that water can be run through it to carry off some of the heat, the cap making a water-tight joint with the top of the shoe.

Ten-minute runs without cooling have proved most satisfactory, the excessive wear of some of the shoes rendering a longer run impracticable.

The heat generated is great, so that it is impracticable to measure it accurately. All shoes get more or less red hot on the edges, and as no marked change in friction has been observed which would indicate a change in holding power due to the temperature rising, the question of temperature has not been considered.

Considerable variation in the wear and holding power of shoes have been noticed in the different shoes tested, the results of different tests of the same shoe often varying considerably, but the general averages, as shown in the following, are sufficient to give a distinctive place in the scale for each composition, or shoe metal. As a general thing the results are practically duplicated. As an illustration, duplicate tests on four shoes are shown (Diagram A), plotted in the form of curves, showing the change of pull or friction at each minute observation. Here the horizontal lines denote the pounds shown on the friction scale and the vertical lines the time of observation. The comparative friction or holding power of the various shoes is graphically shown on Diagram B, which represents successive runs of each shoe, and the general average of each set of runs. The runs noted are not made all at the same period for each shoe; that is, shoe marked 1 has been tested three times, but tests may be made at intervals of several days, other tests having been made on the same wheel in the meantime. They represent, however, the first, second and third run of that shoe, and in the case of No. 1 show both in wear (Diagram C) and friction (Diagram B) that the metal is softer toward the center of shoe, or as the shoe wears down, No. 1 in this case being a soft cast-iron shoe. Other shoes act exactly opposite, as shown by No. 2, which shows diminished friction and wear as the tests are repeated. No. 4 represents a plain wrought-iron shoe. The form for the record of the brake shoe tests is as follows:

Brake Shoe Tests.

No.....	Date.....
Kind of shoe.....	Wt. of shoe before.....
	" " after.....
Made by.....	Loss.....
Kind of wheel.....	Tem. water before.....
	" " after.....
Load on shoe.....	Heat of shoe.....

Time.	Friction scale.		Speed.		Remarks.
	Reading.	Actual.	Revs. in 2 mins.	Miles per hour.	

The results here indicated represent but a small portion of the records obtained to date, and are all confined to the cast-iron wheel with chilled face. The indications point to practically no wear of wheel or injury to wheel by the brake shoe, but they clearly show the superiority of some shoes over others for the purpose.

This information is published for the purpose o

indicating what the committee is doing in the way of testing brake shoe material and the nature, comparatively, of the results obtained. Similar tests are now being made against a steel-tired surface.

An Experience in the Sinking of Foundations.

It has been my fortune to encounter a case of subsidence of a masonry abutment founded on compressible soil, and, as the data are quite complete and the example rather an extreme one, I propose to describe it briefly as a matter of professional interest.

The structure is the abutment of a highway bridge in one of our large cities, and serves to support one end of a 150-ft. span of iron truss, besides serving as a retaining wall at the end of the earth embankment which constitutes the bridge approach.

The foundation is of Portland cement concrete, 7 ft. in depth, and the main wall is 22 ft. high above the top of the foundation. The material in the embankment is a clayey gravel, having an angle of repose of about 1½ to 1. The location is a river bank about 10 ft. above low water. The foundation pit showed evidence of the material being made-ground, and the advisability of founding on piles was considered but finally abandoned on the evidence of the following tests.

Test borings showed a bed of clayey gravel 5 ft. deep below the foundation, and below that a rapidly increasing percentage of river mud, until, at 10 ft. below the foundation, mud alone was found. A wooden block with a base 1 ft. square was placed on the pit's bottom and loaded with 2¼ tons. It settled ¼ in. during loading and 24 hours later showed no further settlement.

The bottom apparently justifying a direct foundation on the soil, a few inches of sand were spread and the concrete put in to the depth described, 7 ft. This concrete was practically a monolith, and its value as such has been forcibly illustrated by the event. Bench-marks were established on top of the concrete by imbedding iron spikes in the top layer, and it is the comparison of these from time to time that has been the evidence of settlement.

At the time the masonry was completed a settlement of 1½ ins. had occurred; the pressure per square foot of foundation being then 1.06 tons.

Two days after the iron trusses were sprung no further settlement had developed, but upon the addition of the wooden floor system and the construction of the earth fill behind the wall, a further settlement of 1½ ins was discovered, the pressure on the foundation being then 1.12 tons per sq. ft. A month later an additional settlement of ¾ in. was observed, which is attributed to the vibration from railway travel, the tracks being but 10 ft. from the face of the masonry.

The total weight of the structure with its dead load of bridge is about 1,500 tons, and the area of its foundation base is about 1,300 sq. ft.

The settlement has been slightly greater at one end of the wall than at the other, and greater in front than behind; but a study of the differences of settlement shows that no distortion of the mass of concrete in the foundation has occurred, and there are no signs whatever of any failure of the masonry above the foundation. In addition to the total settlement of 3 ins, here described, there was undoubtedly a small settlement of the foundation during its construction.

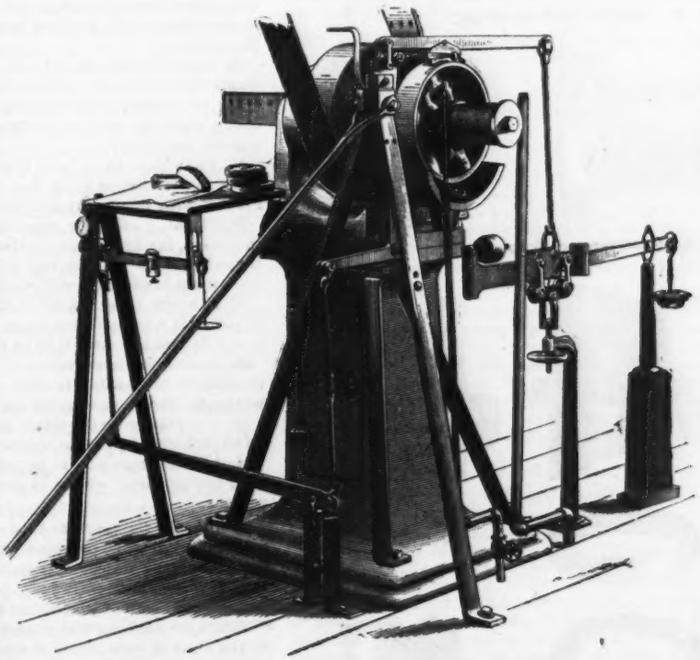
It is worth remarking in connection with these facts that the settlement of walls is not usually observed as carefully during and after construction as this one was, and that analogous behavior may be of not infrequent occurrence, though not noted. The practice of observing such matters may often develop information of the greatest practical interest.

It may also be observed that no considerable dependence can be placed upon tests made by loading small areas of a pit's bottom, especially where the material founded upon is only a crust overlying a compressible or otherwise insubstantial stratum. Such evidence is not absolute and is barely confirmatory.—*The* (Rensselaer) *Polytechnic.*

[The error lay in assuming that because 2¼ tons on 1 sq. ft. would not cause the loose material below to yield, therefore 250 tons on 100 sq. ft. or 2,500 tons on 1,000 sq. ft. would not do so.—ED.]

The Proposed Montreal Bridge.

The bridge extends from a point on the south shore of the river St. Lawrence, near the town of Longueuil, and about two miles east of the celebrated Victoria Bridge. From the south shore to Ile Ronde the distance is about 4,000 ft. The water is very shallow, averaging only 2 to 4 ft. in summer for about three-fourths of the distance, and from 5 to 8 ft. for the remainder of the distance. The bottom is rock for the whole distance. Ile Ronde is about 1,100 ft. wide, and it is also composed of rock. The main channel of the river is between this island and the wharves on the Montreal side, and the depth of water is generally from 20 to 30 ft. The rock slopes gradually from the shore of the island toward the Montreal side. At the edge of the wharf, on the Montreal side, there is about 10 ft. of water and about 30 ft. of sand and clay to go through before reaching the rock. It will be seen from this that the question of foundations will not be a serious one. It would be very difficult to have a more favorable combination of circumstances.



Brake Shoe Testing Apparatus, C., B. & Q. R. R.

From the Longueuil side to the island the intention is to use spans of 200 ft. There will be 22 of these spans. On the Montreal side there will be 10 spans of similar length. The main channel span is 1,300 ft. in length and the anchor spans of the cantilever are each 500 ft.; the total length being 8 440 ft. For 800 ft. of the main span there will be a clear headway for vessels of 170 ft., being 35 ft. more than the Brooklyn bridge, and 20 ft. more than the Forth bridge.

The bridge provides accomodations for two lines of rails, a double roadway and two foot walks. The railway terminus is intended to be in the central part of the city, but for obvious reasons the site is not mentioned. It will be reached by an elevated railway passing through the centre of the blocks and not interfering with a single street. The grade cut on the southern approach to the main span will be 105 ft. per mile, and on the northern side it will be 132 ft. per mile. The plan of the superstructure was prepared by the Canadian Bridge & Iron Co., of Montreal.

There is at present not a single highway bridge across the river St. Lawrence, and at Montreal the necessity of such a bridge is much felt every winter, as for nearly three months of each year it is impossible to cross the river with a vehicle. As the greater part of the farm produce, hay etc., consumed in the city, comes from the south side of the river, it will be understood that this stoppage of traffic becomes a serious matter. In the summer time five lines of ferry boats ply from different points on the two shores, but this mode of transit is slow and expensive.

The Victoria Bridge, owned by the Grand Trunk Ry., provides the only means of access to the city by rail, and through it that company has retained a monopoly of all business coming to the city. Two lines of railway—the Great Eastern and the Montreal, Portland & Boston—have their termini at Longueuil, and other lines propose to extend to that point as soon as the bridge is constructed, so that ample railway traffic is assured. On the Montreal side connection will be made with the different lines now entering Montreal.

The total cost of the bridge and terminus at Montreal is estimated at $5,000,000. We understand the prospect for early construction is excellent. Mr. C. N. ARMSTRONG is managing director of the company.

Street Cleaning in Berlin.

In 1887 there were 1,444,000 sq. yds. of granite pavements, 84,480 sq. yds. of wooden blocks and 483,680 sq. yds. of asphalt, more than one-third of the streets being laid with these systems. The asphalt pavements met with little favor at first, especially among cab drivers, on account of their smooth surface. Now they are liked, especially since the new system of cleaning has been adopted, which is the bag method in use on parts of Broadway, Twenty-third street and Fifth avenue, in this city.

The streets are cleaned during the night, 600 laborers being employed as a rule. The revolving sweepers are city property, but the horses belong to the contractors, who have charge of removing the refuse and are also obliged to maintain suitable dumping-places. The sweepings are of some value, contractors oftentimes realizing over $20,000 from them. They are obliged to remove the rubbish as soon as it is swept up, and only in cases of bad weather are the sweepings allowed to stand more than an hour before being carted away. If these regulations are broken, the contractors forfeit a certain amount to the city.

The entire work is done under the supervision of a street cleaning commissioner, who is directed by a board of four lawyers and eight members of the city government.

All streets that are regularly cleaned are also regularly sprinkled, usually twice a day, but sometimes more frequently. The city provides 147 watering carts, which the contractors are obliged to keep in good condition. The carts are filled by city laborers.

The three horse car companies bear a large part of the expense of cleaning. In 1886-87 they furnished $21,000. According to the *Zeitschrift fur Transportwesen and Strassenbau*, from which the above details are taken, the annual cost of cleaning and watering the streets amounts to about $375,000.

Forestry Interests of the United States.

The following rough estimates have been prepared by the Forestry Division of the U. S. Agricultural Department:

Acres covered with wood growth, or 26 per cent. of total land area	450,000,000
Acres burned over in Census year, 1880	10,274,089
Corresponding loss estimated at	$25,462,250
Acres cut over annually	25,000,000
Wood consumed annually:	
Timber and lumber, cu. ft	4,800,000,000
Railways, " "	500,000,000
Fences, " "	500,000,000
Fuel, " "	18,000,000,000
Mining timber, " "	150,000,000
Total " "	24,000,000,000
Value of wood consumed annually	$1,000,000,000
Wood growing annually on the present forest area of the United States, cu. ft	12,000,000,000
Saw-mill capacity of the United States, ft. B. M	60,000,000,000
Timber lands belonging to the United States Government, acres	70,000,000
Value of timber reported stolen from public lands during seven years	$36,719,935
Amount recovered during same period	$478,073
mount expended for protective service	$475,000

Joints for Steel "Spiral Weld" Pipes.

In almost all substitutes for cast-iron hub-and-spigot pipe the method of making the joint is a serious and sometimes troublesome feature. The value of the pipe, for all useful purposes, depends on the couplings, no matter how excellent the pipe may be in itself, and upon the ease with which the connections can be made and the tightness of joint secured with the minimum of cost and trouble.

The steel pressure tubes, made by the Spiral Weld Tube Co., of East Orange, N. J., have a proof strength of stock of 40,000 lbs. per sq. in., but to utilize this strength several novel couplings have been devised, as here shown.

To meet the requirements of water companies a hub-and-spigot coupling is made on the American Water-Works Standard, as shown in Fig. 1. Here the regular casing is slipped on the end of the pipe and the space *a* is packed with oakum and tightly calked, and the space *b* filled with lead and calked. The end of the pipe is then expanded with a hand-hammer until it is simply impossible to pull it off. In the subsequent treatment with hot asphalt the oakum becomes thoroughly impregnated, and the seal is made perfect. Joints of this kind has been tested in an 8-in. pipe up to 900 lbs. per sq. in. without leakage. This pipe can be cut in the field at either end by heating it and melting out the lead at *b* and then slipping the casting back over the pipe to be cut. As the pipe can not be again dipped in asphalt it is well in such cases to calk both *a* and *b* with lead. As the pipe itself is soft steel it can be expanded cold without cracking. The service-tap boss (not shown in Fig. 1) is cast on to the collar of the hub. This form of coupling also makes it possible to interchange the steel tubing with cast-iron pipe, and to use all manner of regular water-works specials with it.

Fig. 1.—Hub-and-Spigot Coupling.

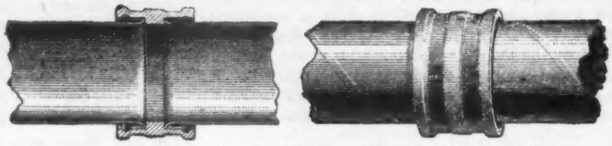


Fig. 2. -Double Hub Coupling.

For long stretches of pipe a double hub is used, as shown in Fig. 2. It is lighter, cheaper and more convenient than the regular form. As shown, the ends of the pipe are flared and put into the double hub; the latter is then packed with oakum or gasket, and the lead poured and the joint calked in the usual manner. A cheap, strong, and permanent joint can be made with this coupling with "Spence's metal," which costs about one-third as much as lead. It is indestructible, will stand all changes of temperature, and fills the joint perfectly without calking. It is poured like lead, but it is more fluid. For cheaper work still, Portland cement can be used.

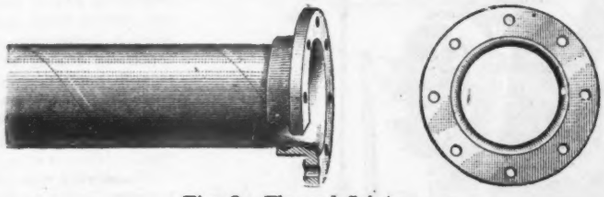


Fig. 3.—Flanged Joint.

For steam, hot liquids, compressed air, etc., a flanged joint is preferred, and this is shown in Fig. 3. In this joint, especially designed for the convenience of the user who may have to cut his pipe at times, the connection is made essentially in the same manner as was described for the hub-and-spigot coupling. The packing spaces *a* and *b* may be calked with lead, when the service permits. But for steam pipe, a rust-joint of iron borings and sal-ammoniac is better.

The joint shown in Fig. 4 is a peculiarly ingenious one, especially designed for the requirements of natural gas distribution; though it is equally well adapted to the conveyance of artificial gas, compressed air, water, petroleum, etc. The pipe is shipped as shown at *A*, with the loose collar and flanged end; *B* is a lead packing, which is sawed to a proper length in an ordinary miter-box, and easily shaped by a mallet; *C* shows the flanged pipe ends brought together, and the lead packing being hammered in place, and *D* and *E* show the lead and pipe flanges pinched and tightly held by the bolting together of the cast-iron flanges. This joint requires no skill to make, and is safe and durable under contraction or expansion, sagging, vibration, etc.

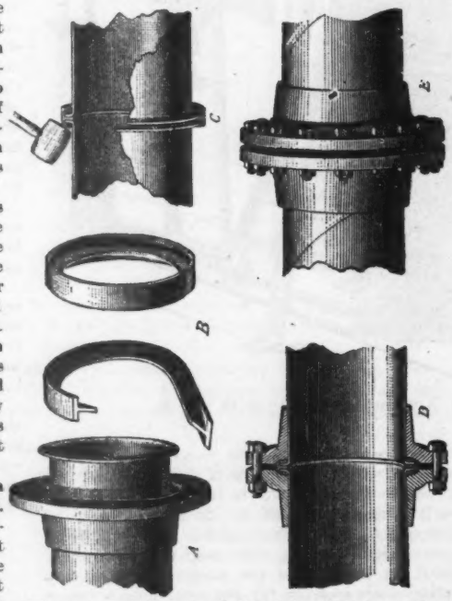


Fig. 4.—Coupling for Artificial and Natural Gas.

Austrian Shop Regulations.

The Austrian Society of Engineers and Architects has recently issued a series of regulations tending to increase the safety and comfort of mechanics, a part of which we translate for our readers:

A. REGULATIONS GOVERNING THE SHOPS.

(*a*) *Rules concerning the workrooms:*

1. The rooms must be so designed that each man shall have at least 13 cu. yds. space, 0.6 sq. yds. of window, and 2.4 sq. yds. of floor. Deviations from this rule will be permitted by the Board of Supervisors when a change of 26 cu. yds. of air per person and hour is assured.

2. Workrooms, lavatories, passages and stairs must be sufficiently lighted during the hours of labor.

3. All doors which lead from the work-rooms into the open air are to swing outward if possible.

4. Occupations where there is special danger from fire must be provided with enough appliances to render the escape of every employé certain.

5. Stairways must be kept in good condition and be provided with fixed railings. In case a flight of steps is built against a wall, at least one hand railing is necessary.

6. Openings in floors, scaffolds, platforms, galleries, and inclined planes are to be so arranged that men cannot fall from them or objects drop upon workmen below. All channels, ditches, basins, pans and boilers which contain a greater depth of water than 31.5 ins., or have poisonous, corrosive or hot fluids, must be so surrounded that men cannot fall into them.

7. Occupations involving injurious dust, gas or vapor, are to be protected from the same by suitable apparatus.

8. Rooms in which explosive gases occur or are developed may only be lighted from the outside or by safety lamps.

9. Wells or other places containing noxious gases are not to be entered until tested for such danger.

10. The principal entrances into workrooms must possess a breadth of at least 3 ft. 3 in., while minor entrances must be 2 ft. or more wide.

(*b*) *The disposal of machinery in the workrooms:*

11. All moving parts of machinery must be so covered or enclosed that there is no danger of touching them. The same rule applies to shafting when its position does not act as a safeguard.

12. No projecting parts, like screw heads or ends of wedges, must be left on rotating machinery, shafting or the like.

13. The starting of the shafting must be signaled to every room in a manner plain to each workman.

14. Means for signaling to the engine room to stop must be provided in each room.

15. Whenever a number of machines are run by the same engine, means are to be provided for disconnecting each machine from the others or from the engine.

16. Each machine must be so arranged that it can be started or stopped independently of the others.

17. All apparatus for stopping machinery must be easily reached and so arranged that it works quickly and surely.

18. Belts that have been thrown off must be entirely removed or so hung that they do not come in contact with moving apparatus.

19. Cleaning, oiling or repairing machinery while in motion, laying ladders against revolving shafts or throwing belts on moving pullies is only permissible when unattended with danger.

20. In every room a copy of Rules 18 and 19 is to be posted in a conspicuous place, and wherever there is any danger the same is to be plainly indicated.

21. Access to places where contact with moving machinery is possible is only permitted to those workmen who wear close-fitting garments.

22. The glasses on the water gauges of boilers are to be protected by proper appliances.

24. All elevators are to be plainly marked with their lifting power, either in pounds or number of persons.

(*c*) *Rules for the comfort of the workmen:*

24. Places must be provided where the clothing of the men can be protected from dust and injurious fumes.

25. Every establishment is to provide proper facilities for washing and, if necessary, warm water at the close of each period of work.

26. Every establishment must provide all the pure, fresh drinking water wanted, and the same is to be easily accessible to the men.

27. Persons subject to epilepsy or fainting, and all irresponsible people, are to be kept away from dangerous places. Intoxicated men are not to be allowed on the premises.

28. In every establishment, suitable provisions are to be made for immediate aid in case of accident, for suitable medicines and bandages, and for the immediate presence of a physician. A proper number of men shall be instructed in the use of simple remedies.

29. In every establishment, the rules and regulations concerning management and accidents are to be posted in easily accessible places, and to be always at the men's disposal.

B. REGULATIONS FOR THE BEHAVIOR OF THE MEN.

30. Every man employed in a shop must possess the qualifications necessary for a person in his work, and must be acquainted with the dangers, if any, to which he is exposed. Every new man must be made familiar with these dangers.

31. Every workman must keep his working place clean and in order; he must keep the tools and machines intrusted to his care in good condition, and see that all articles are kept in safe positions.

32. Every man is obliged to give aid at once in case of accident, to use the stopping and signalling apparatus, and notify the nearest foreman.

33. Every workman is forbidden to enter rooms in which he is not employed, especially boiler and engine-houses. Lounging near other machines or places than his own is not allowed. No gathering or commotion near dangerous places will be permitted.

34. Each workman is to wear suitable clothing, closely fitting as possible. The garments are to be kept in good condition and regularly washed.

35. Every workman is obliged to implicitly obey the workshop regulations, especially those about dangerous machines and places, and to carefully follow the rules for his safety and comfort.

JOHNSTOWN is prosperous once more. On May 31 it was a year since the great flood, and it seems to have fully recovered from the blow. The output of the new Cambria Iron Works for the last six months has been greater than that of the same period of last year, and the employment of labor has been proportionate. The Gautier Steel Works, operated by the same company, has been rebuilt, and will be enlarged. The rebuilding of the town has gone on rapidly. There has been spent in rebuilding houses and bridges $380,000. There are now in course of erection buildings costing upward of $141,000. Many of the men who were in business before are recovering and are again prospering. The dwellings that have taken the places of the ones swept away are mostly better in every way.

THE BRICK PAVEMENTS of Peoria, Ill., are made of blocks 4 ins. thick, 12 ins. long and 3 ins. deep. These are laid on 5 ins. of well compacted gravel, and the joints are filled with coarse sand and distilled tar. The blocks are hand-made and smooth and uniform in size, and the upper edges of the brick are champered off. Decatur, Ill., has 10 miles of brick pavement, some of it in use since 1884. It gives much satisfaction. The foundation is 4 ins. of gravel, then common soft brick laid flat with two ins. of sand on top, and the surface is made of hard-burned common brick set on edge, with the joints filled with sand and distilled tar.

THE OWNERSHIP OF LAKE TAHOE is the first dispute raised under the new projects for the conservation of water within the public domain. San Francisco wants the water for domestic and manufacturing purposes, and Nevada protests and says that that State needs all this water for her own use and the development of the Truckee Valley. The trouble is that only half the lake lies in California. Congress can alone decide, and it has the power to so distribute it as to do the most good to the greatest number. The San Francisco *Call* thinks that the direction of this distribution is westward.

PERSONALS.

Commissioner POST was re-elected last week President of the New York Dock Board.

Mr. CHARLES HAMILTON, superintendent of the St. Louis Division of the Mobile and Ohio R. R., has resigned.

Mr. J. F. GODDARD, Vice-President of the Atchison, Topeka & Santa Fe R. R., has resigned, his resignation to take effect June 1.

Mr. R. S. STOVER has been appointed assistant engineer of the Henderson Division of the Louisville and Nashville R. R., with headquarters at Evansville.

Mr. A. B. PLOUGH, general manager of the St. Paul & Duluth R.R., has been elected president of the St. Paul Union Depot Co., vice F. R. AINSLEE, resigned.

Mr. E. T. JEFFERY, formerly General Manager of the Illinois Central R. R., has, it is stated, accepted the Vice-Presidency of the Lake Shore & Michigan Southern Ry.

Mr. CHESTER B. DAVIS, C. E., has submitted plans for the sewage of Aurora, Ill., but there is some difference of opinion between himself and City Engineer DUNNING as to details.

Mr. C. C. ANDERSON, C. E., of Hawkinsville, and Prof. E. T. WHATLEY, of Newman, have been appointed by the Governor assistant State geologists of Georgia, from July 1.

MR. HORACE ANDREWS, of Albany, N. Y., has been re-nominated for the office of City Engineer, and the nomination has been unanimously confirmed by the Common Council.

Mr. J. N. MILEHAM, formerly Master Car-Builder of the New York, Lake Erie & Western R. R., has been appointed Assistant Superintendent of the Pullman shops at Wilmington, Del.

Mr. J. M. KRAEMER, of Philadelphia, and the engineer of the Disston purchase in Florida, is appointed by the Governor of Georgia, to survey and map the Okefinokee swamp and vicinity.

Mr GUY C. GOSS, of Bath, Me., died in that city lately, aged 68 years. He was a leading shipbuilder, established the Bath Iron Works in 1886, and built the marine railway in that city in 1882.

Mr. C. F. MEEK, has been appointed general manager of the Gulf system of the Union Pacific Ry. Mr. MEEK was formerly general manager of the Denver, Texas & Ft. Worth Railway, now controlled by the Union Pacific.

Mr. E. C. KINNEY resigned his position with the Union Pacific Ry. and engaged with the Anaconda Smelting Co., for the special work of developing the water electricity to the power of a mountain stream and transmitting it by works for power.

Mr. DAVID L. HOUGH died in Chicago last week, aged 70 years. Mr. HOUGH came to Chicago in 1873, and since then had been prominently connected with nearly all the big street railway schemes in that city. He was president for some time of the Passenger Ry. Co.

Mr. E. T. SMITH, Superintendent of the Western division of the Georgia Pacific Railroad, has resigned, to accept a similar position with the Atlantic & Danville road in Virginia. Chief Engineer of Maintenance HAMMOND, of the Richmond & Danville road, has been appointed to succeed Mr. SMITH.

Mr. HENRY HEATON, a wealthy citizen of Leesburg, Va., and well known in London financial circles, died recently. He was an Englishman, but served in the Confederate artillery and on General Early's staff. At the time of his death he was a member of the Virginia State Senate, a director in the Washington & Ohio branch of the Richmond & Danville R. R. system, and a large stockholder in the latter company.

Mr. J. W. KEELER has been elected City Engineer of Danbury, Conn. In noting the election, the Danbury *News* says the first vote was a tie between Mr. KEELER and another candidate. The breaking of this tie rested with the Mayor, who made the peculiar statement that his sympathies were with the other candidate, who was more familiar with the sewerage system, but "as Mr. KEELER was the choice of the party caucus" he would vote for him.

SOCIETY PROCEEDINGS.

Liverpool Engineering Society.—Meeting of May 7; Mr. Henry H. West, M. Inst. C. E., President, in the chair. The ballot for officers for the ensuing session resulted in the election of F. Hudleston, Assoc. M. Inst. C. E., President; John T. Wood and James Morgan, Assoc. M. Inst. C. E., Vice-Presidents; J. H. T. Turner, B. Sc., Assoc. M. Inst. C. E., as Hon. Secy.; O. S. Pilkington, Assoc. M. Inst. C. E., as Hon. Treas.; J. A. Brodie, Assoc. M. Inst. C. E., as Hon. Librarian.

Mr. Henry H. West, the retiring president, in announcing the result of the ballot to the meeting, congratulated the members upon the growth and vigor of the Society. There were 190 members of all classes on the books, and the income for the past financial year had amounted to £150. Being in this position the Council had felt justified in printing and issuing the papers read to members prior to the date of the discussion of the papers. The result had been to add greatly to the interest and value of the discussions, and the Council felt that the result justified the additional outlay involved.

Mr. West then announced that arrangements would be made for excursions during the summer to the Thirlmere Aqueduct, Manchester Ship Canal Works, Menai Straits, Forth Bridge and Edinburgh exhibition, Liverpool Overhead Ry. Works, L. & Y. Ry. Works at Horwich. The adjourned discussion upon Mr. Thomas L. Miller's paper, entitled "The Efficiency of Gas Engines," concluded the business.

Western Railway Club.—At the meeting on May 20 the discussion on counterbalancing locomotives was continued. Mr. Lewis corrected a statement he made at the April meeting, saying that only the 10-wheel engines on the Chicago, Burlington & Northern were counterbalanced with the full weight of the reciprocating parts. In regard to the method of counterbalancing, Mr. Lewis said:

If the proper methods were employed in counter-balancing, it would not be necessary to estimate the weights of the hubs and pins. Our method has been to rest the journals of the driving wheels on parallel strips, properly leveled, and when the counter-balance of the wheel is on the bottom quarter on one side, sufficient weight can be added at the pin on the opposite side, to rotate the wheel, and bring the centre of the pin to a horizontal position. This will establish the true revolving balance in that wheel, and enable us also to ascertain that portion of the reciprocating weights in the counter-balance, by subtracting the *known* weights of the revolving parts from the total weight suspended on the pin; the difference representing the portion applying to the reciprocating weights.

Mr. Rhodes and Mr. Barr referred to the flat spots on the left main driver on four wheel connected engines which develop at the point where the tread touches the rail when the left pin is just passing the forward center. It is especially noticeable on sandy roads, but seems to affect certain engines, while others exactly like them are unaffected, this being probably due to slight differences in the character of the tire. Mr. Lewis explained that the flat spot was due to the excessive counterbalance. Mr. Wm. Forsythe explained the system of blanks with headings furnished to C., B. & Q. Master Mechanics for their guidance in counterbalancing locomotives.

After an intermission the subject of journal bearings was taken up. Mr. F. B. H. Bouter exhibited the Ham mond automatic oiling-box. Mr. Verbryck gave his experience with the Sharpneck roller journal, as follows:

We equipped one four-car train on July 3, 1889, with the device, and it has been running since that time without any trouble at all. We have changed wheels frequently, because of usual defects, but we couldn't beat the journals. The last time we had the cars in we examined the journals and rollers, and the wear was almost imperceptible. I can testify that the device is a success, so far as running is concerned. As to the question of cost, that is an entirely different thing. The boxes are rather costly as they have been manufactured; but I presume that if the Sharpneck Company manufactured them regularly, they could bring the cost down.

Mr. R. D. Smith described this trouble with brasses wearing thinner at the front end than at the back, and said, "I believe what we want is a journal box that will feed clean oil to the journal."

There was a little discussion on "The Comparative Flange Wear of Wheels," and it was then voted that a committee be appointed on this subject and on the subject of "Relative Cost of Maintaining Rigid Center and Swing Center Bearing Freight Car Trucks," and to report at the next meeting on Sept. 16.

American Water-works Association.—The tenth annual convention of the American Water-works Association was opened promptly in the Grand Pacific Hotel Chicago, Ill., at 10 A. M., May 20; President, J. H. DECKER, of Salina, Kan., in the chair; Secretary J. M. DIVEN, of Elmira, N. Y., and over two hundred members, of all grades, and visitors, in attendance. In the absence of Mayor CREGIER, the address of welcome by the city was made by Comptroller ONAHAN, acting mayor, *pro tem*. A letter from Mayor CREGIER was also read. After the usual routine business of roll-call and election of new members, the deaths of JOHN G. BRIGGS, of Indianapolis, Ind., an original member of the society and a past president, and of CARROLL E. GRAY, of St. Louis, Mo., a former member, who died recently at Waukesha, Wis., were announced.

President DECKER then read his address to the Association, which he opened with the usual laudation of the "great metropolis of the West," which, phœnix-like, has arisen from her ashes in greater grandeur and magnificence than ever, &c., &c. He then referred to the original organization of the American Water-Works Association in St. Louis on the 29th of March, 1880, with 24 "determined spirits" in attendance, representing 12 water companies and departments, now increased to over 300 members, and representing nearly 200 different companies and departments, in the United States, Canada, Newfoundland, England, India, and Japan.

The business of the present convention "is for conferring together, comparing notes and experiences, hearing written and oral opinions as to the best methods of improving, extending and conducting our business, not only for our own benefit, but for the benefit of the communities we serve." In the dealings between water companies and their customers there should be "a careful avoidance of any discrimination, either in the way of rates or privileges," and there should be a "straightforward and firm but courteous enforcement of such reasonable rules and regulations as will protect both the interests of the company and the consumer." In dealing with the average city council the policy of conciliation will generally break down the most persistent antagonism.

The members of the association, although many of them have devoted the best years of their lives to the study and practice of their business, were yet students, and willing and anxious to learn from those who can teach, and to profit by the experience of others. "Out of the labors of this association there ought to grow, and there is growing, a higher appreciation of our work, and I look forward with confidence to the time when our labors will be recognized and accepted as one of the agencies tending to the elevation of our national character."

The members of the association meet not only for the discussion of business interests, but of any suggestion or inquiry made by any member in the interest of pure water delivered to the people, which is the principal aim, the reason for the existence, of water companies, so that "if any member has a question to ask or a knotty problem to present, upon this floor is the proper place to make it known, for such is the purpose of our organization."

"The past decade has been one ever to be remembered in water-works history. In 1881 there were in the United States 629 water-works, and in Canada 31; to-day there are in the United States 1,220, and in Canada 30, a growth

of 200%, or twice as many as were constructed in the preceding century.

The capital invested is about $500,000,000, the annual revenue closely approximates $50,000,000, the length of mains is nearly 30,000 miles, with over 2,000,000 taps. This same period has given birth to the mechanical filter; it has given us marked improvements in pumping engines, a higher degree of efficiency in the meter, and a degree of excellence in all classes of supplies hitherto only hoped for."

The next decade will undoubtedly witness still greater progress in the same directions. The great demand of today is a satisfactory meter, and an efficient means of filtration, and through the labors of this association the time is not far distant when we shall have both.

It is stated in our annual circular: "As each year rolls around we are more strongly impressed with the necessity of united effort to place the business of water supply upon a higher plane, and of conducting it upon a more uniform and systematic basis."

That such is the case not a gentleman upon the floor will deny; then may I ask why is it that of the 1,900 water works in the United States and Canada less than ten per cent. are represented in this association? At a low estimate 50 per cent. should be enrolled, and there should be 500 active, zealous managers upon this floor to-day. It certainly cannot be said that our association has not been widely advertised and its aims and objects made known. Nor can it be urged that local organizations are supplying the want; there is a lack somewhere. Is it that the individual members take no interest in building up the ranks? Or is it not rather more largely due to the indifference of boards of commissioners and directories, and to the fact that they will not, or do not, make it obligatory upon the managers to attend and provide for the expense of so doing? For it cannot be expected that the managers of the smaller plants will pay their own fees and dues with the additional expense incidental to our annual gatherings. They cannot afford it from their salaries. Let us then endeavor to impress upon those most deeply interested in the success of our association the necessity for their cordial and financial support.

Thanking you heartily for the honor conferred upon me, I believe I may safely rely upon your assistance to make this, the tenth annual meeting, as successful in every particular as were its predecessors."

The practical work of the convention was opened by Mr. BULL, of Quincy, Ill., as Chairman of the Committee on "Electrical Boiler Devices," appointed at the Louisville Convention. His attention had been called to the apparatus for "ageing" wine by an electro-magnetic current, and he tried the same arrangement to see if he couldn't prevent scale from forming in boilers. After a while he concluded to drop the electro-magnetic appliances and see what could be done with permanent magnets. So he rigged up an iron cylinder in which he made a series of "grids" of bar steel permanent magnets, through which the water fed to the boilers was made to pass. He found that instead of the mineral impurities of the water adhering to the boiler and the tubes it formed a soft sludge in the bottom and left the heating surface clean. He tried it on a boiler attached to a lime burning establishment. The water came from a well sunk near by. It was pure, but it was excessively hard. The scale in that boiler was as hard as Portland cement. The application of the magnetic cylinder caused that hard scale to become as pliable as fresh mortar. It could be scraped out just as easily as a man could scrape off fresh mortar from a wall. It seemed to destroy the bond of the scale as ice is permeated by spicules when it has stood in the sun. The sludge under the microscope showed that it was a mass of irregularly crystalized particles. He had only three months' experimenting with the permanent magnets, but in six months' longer time in which to try its effect on other waters than those containing the carbonate of lime he believed that another use could be added to the lengthening list of magnetism.

Mr. DONAHUE, of Davenport, Ia., one of the committee, testified to the cleanliness of Mr. BULL'S experimental boiler at Quincy as being "just as clean as a brand new boiler," and that with the use of Mississippi River water. The idea that presented itself to Mr. DONAHUE was whether or not the action of the current causing the tremor in the boiler shell, and which prevented the formation of scale, had any effect upon the boiler. He understood that Mr. BULL had taken another method of treating the scale, which avoids this objection, if it was any objection, and he would like to ask Mr. BULL if he had made any experiments with artesian water in boilers, this water, composed of sulphur and magnesia, being, as was well understood, very hard on boilers.

Mr. BULL had not experimented with artesian water, the experiments so far having been confined to waters impregnated with carbonate of iron and magnesia. He had no experience with water containing sulphate of lime, but had no reason to suppose that it would be affected any differently from carbonate of lime, although it may be.

Mr. ELLIS had used in similar experiments to Mr. BULL'S, one pint of kerosene every day, on artesian water, and scale nearly an inch thick had been removed from that boiler in the past year, another daily injection of oil had prevented the formation of any more scale. The water is artesian, containing sulphates of iron, of soda, and of magnesia.

Mr. OWEN, of Montclair, N. J., related a case of the favorable use of kerosene for the purpose of boiler cleaning.

Dr. LEEDS, of the Stevens Institute, Hoboken, called attention to the fact that about twenty-five years ago the Franklin Institute had experimented in this direction and had obtained promising results, but that for some reason the promises had not been fulfilled and the matter had been dropped. The plan then in use was to fix permanent magnets inserted through the crown of the boilers and the crown sheet connecting them by wires to the forward end of the boiler.

Mr. BULL: The remarks of Prof. Leeds are of especial interest, because they are new to me. The records of the Patent Office show that there have been a great many attempts to accomplish this thing in methods which have some points of similarity which have a good many things in common. The favorite method of attempting to do this is by an electrolytic process, using a current of electricity. There have been so many patents issued for processes depending for their operation upon the electrolytic principle which have never come to anything, so far as I can see, that I have never had much confidence in the operation of any such principle. The use of magnetism as opposed to electrolysis has in more than one instance been successful in doing this thing. Any one who has even dabbled in this subject a little knows that there is nothing more certainly fatal to the strength and operation of a permanent magnet than any degree of heat above that which we are accustomed to find in the atmosphere. You take a lot of permanent magnets in a shell of a boiler and subject them to a temperature of 300°, and in 24 hours they are so much scrap iron and nothing better. Another difficulty of experimenters—dealing with the whole boiler—I avoid by working with the feed pipe, the feed-water, instead of attempting to dabble with a whole battery of boilers. I am also certain that, to be successful, I have got to stop these pipes to the feed-water at some point where the feed-water was cold, that is, moderately cold; not after it had left the boiler.

Mr BULL was continued as a committee of one to report on the same subject a year hence.

After the announcements of the local Committee on entertainments was read by Mr. LINEEN, chairman, the meeting adjourned.

At the opening of the afternoon session at 2.30 o'clock, Mr. RUSSELL, of St. Louis, Mo., read the report of the Committee on Standard Cast-Iron Pipe.

MR. CAMERON: I think this matter ought to be discussed thoroughly. Pipemakers claim that they test all their pipe up to 300 lbs. pressure, no matter what the thickness of it is. It has been intimated that water companies in the past have been putting too much money in the ground; that a light pipe tested up to 300 lbs. to the sq. inch, is just as good as a heavy one.

Mr. RICHARDS: There are times when the pressure runs up to 500 lbs., and the pipe has got to stand that. Provision for "water-hammer" has also to be made.

Mr. TUBBS: My plan of inspection at the foundry is for the inspector to take a steel pick of 3 or 4 lbs. weight and the moment the pipe comes from the casting on to the skids he takes that steel pick and drives it through every part of the pipe; if there is any part that is not homogeneous, the pick will go through and make a hole in it. The pick inspection is better than hydraulic inspection of 300 lbs. pressure. To an inquiry by Mr. GARDNER, later on in the discussion, Mr. TUBBS stated that the pick would penetrate ⅛-inch thickness of any pipe of good or bad iron, but would not penetrate good iron of ¼ in. thickness. Mr. TUBBS' idea "in a nutshell" is that the engineer cannot determine to a nicety what can be done in any single case; he has got to be in consultation with the manufacturer, and the manufacturer takes in another element, the transportation test. He knows just what the shaking up and the jarring of cars, etc., amounts to, and he says, if you will make it a certain thickness, I will take the chance of transportation; then the engineer can take the chances after his pick inspection and his hydraulic inspection.

Mr. LINEEN: I consider the "water hammer" largely a myth. It is an unknown quantity. I think there is one safe way of purchasing pipe from the manufacturer, and the sooner the purchaser adopts that principle the better it will be for his service. I require that, after the pipe is laid in the trench, it shall be subjected to a pressure from the pump of 150 lbs. to the square inch, and that is all the test I absolutely do require. I have generally found it successful.

Mr. TUBBS: The kind of iron that is put into a pipe should be watched from first to last. A pipe may come out that is like glass; it would stand 1000-lb. pressure perhaps, but when a connection is to be made by cutting into it, it will be found as hard as glass; it will be difficult to cut; will crack and make all sorts of trouble. I believe, in the case of a large purchase of pipe, that a competent inspector should be sent to the foundry to watch the tests.

Mr. BENZENBERG: We are losing sight of one fact, that the engineer determines the conditions and the specifications, and the manufacturer makes his pipe according to the specification. If the manufacturer has to assume all the responsibility, what is use of the engineer? The engineer understands, in having charge of the works, the conditions under which that works is to be operated, under what pressure the pipe is to be placed, and to what shock it may be subjected. That is not the business of the manufacturer; he agrees to furnish pipe of a certain class of material specified, of certain thickness, uniformly cast. If the pipe does not withstand the shock or the hammer test, it is not the failure of the manufacturer if his material is all right, but the failure or the engineer in not designing the proper size of pipe. The pipe should be, to my mind, inspected at the works, first, as to the material used by the manufacturer, the quality of the iron, whether it has sufficient tenacity or whether it is brittle and will break at a shock. The pipe subjected to a 300 lbs. pressure at the works is supposed to stand all the test that the pipe in the trench will sustain, subjected to a light pressure, and I cannot see but that you are putting your manufacturer again at a disadvantage when you require him to assume the additional responsibility of the laying of the pipe in the trench. A great deal of fault in breaking of pipe is on account of the manner in which that pipe is laid or supported. I do not think, therefore, that you can adopt a standard pipe that will do for all conditions and circumstances. The conditions of the cities may so vary that what is good pipe and a pipe of proper weight for one city is not for another city, and that is a matter for the engineer to determine, and one of the points for which he is engaged.

Mr. LINEEN: Some seven or eight years ago I laid about 14 miles of pipe in a city in Michigan. The pipe had all been certified to by affidavits of the manufacturer and of the men sent to the works as inspectors, as to all the teste of 300 lbs. pressure and the hammer. It was laid with cars and according to specifications. I succeeded in breaking that pipe under the supply from the city under pressures from 20 lbs. to 75 lbs., and finally got it to stand 100 lbs., but I had to replace 6 miles of line. It all stood 300 lbs. in the shop.

Mr. BENZENBERG: The only answer I can give, knowing what I do, is that the inspectors at the shops "had been dined and wined." As to "water hammer," I do not call it a myth; I have watched it and experimented with it, and I do not think it is so uncertain a quantity, but that it can be nearly estimated. It is caused by the flow of water under pressure being immediately stopped, when a rebound takes place, and as the two currents come together a pressure is exerted upon the pipes. I have seen the "water hammer" show its effect for a distance of 1¾ miles from the source; I have seen it in a mile and a half throw down six standard hydrants in the twinkling of an eye, without any apparent account for it; I have seen the water gauge jump from 20 lbs. to 380 lbs. a mile and a quarter from where the hammer was caused. I have seen it jump from 20 lbs. to 480 lbs. in a quarter of a mile and break the gauge. I have broken two or three gauges in that way, and it has been caused in every case where I have examined into it by the sudden shutting off and the consequent stopping of the velocity with which the water is being discharged out of that pipe under pressure, and by its rebound. The amount of "hammer" or ram depends on the volume of water under motion and is stopped, and the pressure to which that water is put. These are the elements from which largely to determine the force of the "water hammer."

Mr. TUBBS: I do not believe that this convention can afford to fix a standard of weights and thickness of iron for water pipes.

Mr. DARLING: I believe that one of the most practical tests of pipe is that made after it is laid in the trench, and I believe builders of pipe should guarantee it after it is laid in the ground. In Pawtucket we have a pressure from 65 lbs. to 130 lbs. In about 12 years we have brought our 6 inch pipe to as light as 26 lbs.; in the Central Falls division we have 6 inch pipe, 22 lbs. to the running foot carrying 95 lbs. pressure, and we have never had a pipe blown out of the ground. My experience is that 12 in. pipe will break or crack quicker than any other size, including the sizes above this. I believe that the pipe manufacturers are honest, and do in regard to test just what they agree to do. I never had an inspector at the works. I feel that we cannot adopt any system of weight here which would apply to every situation that would be called for by pipe. I believe that every superintendent or engineer of waterworks is the best qualified to judge of the situation. To subsequent queries Mr. DARLING stated that he did not recommend the use of 22 lb. 6-in. pipe; he believed that there was an excessive amount of iron used in the manufacture of pipe.

Mr. GARDNER expressed the same opinion. He believed also that provision should be made for water hammer, the existence of which he believed in.

Mr. MILNE: There is no engineer of any wide experience in this country, but will concede that it is essential in all water works that twice the pressure should be maintained in your pipes over your static head. The real practical hammer test is the pick test. It is the point of the hammer driven into the "bell end" and the "spigot end" of the pipe, the weak points. There is no other effectual test. The tensile strength is determined by what is denominated the "bar" test, which every efficient in-

spector is supposed to know how to conduct. This convention could not afford to adopt any standards which would govern any man, but each man must be governed by his own intelligence and experience. I do not think we are using too much weight in iron pipe. The more weight you have in an iron pipe the longer it will last. That is the only safe construction as an economic consideration.

Mr. OWEN: The manufacturers of cast iron pipe on the basis of present practice have determined the certain metals and mixtures in pipe which they use for that purpose. If this association should determine to reduce the normal thickness of all their pipes, the mixtures and the mode of casting would have to be radically changed. You may be able to cast that quality of pipe, but you have two serious difficulties to encounter. In the first place, the quantity of iron used has to be increased. The second question is the danger of handling thinner pipe. I would suggest that we "go slow" in this question, although there may be apparently a question of economy.

Mr. DARLING: I take the average of 30 lbs. for a 6-in. pipe as heavy enough weight for ordinary uses.

Mr. CAMERON: I believe that all pipe manufacturers are honorable men. We have laid pipes in Memphis for 18 years, and never had a pipe break but once after delivery. We have never sent a man to test a pipe. We use the standard weights. This convention cannot adopt a standard any more than they can arbitrarily say that the pipes shall be laid two or four feet under the ground.

Mr. YARDLEY read a specification of pipes. The paper has already been read before the American Institute of Mining Engineers. Mr. YARDLEY was made chairman of a committee appointed to prepare a series of specifications for cast-iron pipe to be presented at the next convention.

Mayor HAINES, of Newark, N. J., tried unsuccessfully to get the opinions of members as to the comparative merits of wrought-iron, steel, or cast-iron pipes for use in the Newark water supply about to be constructed.

Mr. ARMSTRONG: I do not think this association should make an arbitrary specification whereby the members shall be compelled to make their specification in accordance therewith. I believe each and every man in this association is learning every day that he lives. What is in the specification to-day he may cast aside to-morrow. I think this is wrong. I do not want the pipe men or any man in the business to dictate to this association what their specifications shall be. The question is, what is the best material to enter into the construction of a pipe for the necessary durability?

The paper of C. N. PRIDDY on "Laying and Maintaining of Mains, Hydrants and Service Pipes" was read.

The Secretary then read the paper of L. J. LE CONTE on the "Contamination of Storage Water on the Pacific Coast and the Palliatives Resorted to."

The entire evening session was devoted to listening to a very able analysis and criticism of the paper of Mr. LE CONTE, by Prof. LEEDS, of the Institute of Technology of Hoboken, N. J.

10 A. M., WEDNESDAY.

The first paper read was by Mr. DARLING, of Pawtucket, on "The Desirable Efficiency of Hydrants in Connection with Water-Works." In the discussion which followed Mr. DIVEN stated that he considered a pure water supply for the public health of far more importance than for fire protection. Good, pure water should be the first consideration; after that we can take care of our property. Hydrants should be inspected in cold weather. The discussion brought out the fact that the amount of water used for fire protection in any city was too small to be considered, probably 1¼% of the yearly amount used was a maximum. Mr. BENZENBERG called attention to the great importance of inspecting hydrants in the winter season. The consensus of opinion was in favor of careful inspection in cold weather.

The paper on "Simplified Method of Bookkeeping for Water Departments," by J. P. DONAHUE, of Davenport, was read, followed by Mr. LINEEN'S paper on "The Merits of the Association and the Work Accomplished in the Past Ten Years." Then followed the paper of Mr. TUBBS, of Rochester, on "The Basis on Which Schedules of Water Rates Should be Determined."

Mr. DIVEN: If Mr. TUBBS' plan can be carried out, I think it is a little better than most of us are doing.

Mr. SAWYER did not think an arbitrary rate based upon income could be fixed.

Mr. MILLMAN, of Providence, R. I., thought that there were differences to be considered between the management of water-works by a municipality and by a private corporation. Eight per cent. for renewal of works he considered liberal. Eight years' experience had qualified him in making a positive statement that the only equitable and effective mode of disposing of water is by meter measurement.

Mr. DENMAN considered that it was eminently proper that the water consumer should pay for the meter. The courts have so decided when the question has been raised.

Mr. DARLING believed in selling water by meter measurement. He believed the cost of the meters should be charged to the construction account of the water company. Pawtucket furnishes meters to consumers free. The gain to the company is in saving on the pumping machinery. He claimed that by the introduction of $30,000 worth of meters the city of Pawtucket had saved $60,000 on the pumping plant and the continual running of it. Mr. DARLING stated that "there are but few water-works in the country that are self-sustaining." He did not see how an arbitrary price could be formulated.

Mr. CAMPBELL thought that all private water companies were self-sustaining. For manufactories, breweries etc., meters were a good thing, but it was a mistake to put them in private houses.

At the afternoon session the only paper read was by Mr. C. MONJEAU, of Cincinnati, O., on "Water Supplies," a paper which was much too lengthy to be reproduced in these pages. It was criticised quite severely in the evening by Prof. Leeds and called forth some explanatory remarks from Mr. MONJEAU.

A paper on the "Classification of Water Rates," by C. N. PRIDDY, was read.

Mr. BULL, of Quincy, Ill., exhibited to the association a piece of pipe which he had surreptitiously carried away from the ruins of Pompeii upon a visit there some ten years ago. It was certainly a very interesting relic of the plumbing of the past.

In the regular conversation which comes up annually on the subject of waste of water, Mr. LINEEN expressed himself in favor of consumers letting the water run during freezing nights.

Mr. MILNE, formerly Water Purveyor of Brooklyn, stated: I think every intelligent man thoroughly appreciates this subject. In my opinion a water meter is not only an instrument to save the waste of water, but it educates the consumer of the water to an appreciable sense of what constitutes good plumbing work in a house. It is a silly excuse in most cities that it is necessary that water should be suffered to run to prevent the pipes from freezing. The difficulty is not so much in the temperature, but rather in the location of the plumbing work in the house. The idea of the meter is simply to educate the people to a proper appreciation of the subject. The idea is to save what you have already acquired. Any engineer of sense knows that. Take the city of Chicago, the people of which receive their water by pumping, and although their water supply is unlimited, yet it is perfectly ridiculous that there should be used in this city 170 gallons per head per day. It is perfectly ridiculous to think there is such a waste. That is the point Mr. TUBBS claims in his paper. Every engineer will concede that waste of water is the bane of every water works in the country. There is no doubt of it—wilful waste, criminal waste, and these people are innocent of that waste. There is nothing so cheap as water when you have it, and there is nothing so dear when you do not have it.

Mr. TILDEN stated that he had ascertained by actual experiment that with a 50 lbs. pressure and 1,000 tubes, 1-16 inch diameter running, would consume 12,240,000 gallons in 24 hours: a ¾-in. stream would consume 20,000,000 and a ¼-in. stream 40,000,000 gallons in 24 hours.

Mr. BENZENBERG stated that upon numerous experiments he found that a small stream going through a ⅛-in. faucet that will run continuously in a sink without break or without breaking into drops, represents 90 gallons per hour. One with a little bit further opening of the faucet will represent 140 gallons per hour, one that will run through without force or pressure or merely opening the faucet until it reaches the sink, represents 5 gallons per minute. There is no doubt but that the wastage of water through faucets is an enormous percentage compared with the legitimate use of water during the day hours. I have found, during severe cold weather, that the consumption at night was sometimes in excess of that during the day when the water was being used by all the business houses and manufacturers. The observations made during the night showed wastage fully 100% or one-half of the amount that should be legitimately used, or 50% as wasted. When we began to force meters on to consumers our consumption had reached within 5% of the capacity of our supply and within 3% of the pumping capacity of the works. After placing meters in the business houses in general, within three months it reduced the consumption 40%, and to-day this year or last year, the consumption is considerably below what the consumption was before we began to force meters on the consumers. Now, if the consumer can be as careful as that when he has a meter placed upon his premises, it certainly is not asking him too much to take the same care when there is no meter on his premises.

10 A. M., THURSDAY.

The President read a paper entitled "Who Should Own the Meter, the Company or Department, or the Consumer?"

Upon vote, Philadelphia was selected as the place of the next meeting over Omaha by a vote of 55 to 44. The following officers were elected by a unanimous vote:

President, Wm. B. Bull, of Quincy, Ill.; Vice-Presidents, G. H. Benzenberg, of Milwaukee; Jos. Boyd, Wilmington, Del.; I. L. Lyman, Lincoln, Neb.; R. N. Ellis, Jacksonville, Fla.; H. F. Dunham, Cleveland, O.; Secretary and Treasurer, J. M. Diven, Elmira, N. Y.; Finance Committee, J. P. Donohue, Davenport, Ia.; I. J. Neville, Rochester, N. Y., and Wm. Molis, Muscatine, Ia.

The great Auditorium Building was visited at 4 P. M. to see the working of the hydraulic machinery. In the evening the annual banquet was given in the large dining room of the Grand Pacific. Fully 300 were present, and the occasion was a marked success.

[To be continued.]

LIST OF MEMBERS OF THE AMERICAN WATER WORKS ASSOCIATION IN ATTENDANCE.

Honorary—Y. Nakajima, Imperial University, Tokio, Japan.

Active—H. W. Ayres, C. E. Water Works, Hartford, Conn.; F. C. Barrows, Chairman Water Com., Minneapolis, Minn.; G. H. Benzenberg, Chief Eng. Water Dept., Milwaukee, Wis.; Joseph A. Bond, Chief Eng. Water Dept., Wilmington, Del.; Calvin S. Brown, with Hersey Water Co., Boston, Mass.; William B. Bull, Superintendent Water Works, Quincy, Ill.; A. F. Callahan, Director Water Co., Louisville, Ky.; W. L. Cameron, Secretary and Supt. Water Works, Memphis, Tenn.; D. M. Clark, Secy. and Treas., Water Co., Elyria, O.; Edward Darling, Supt. Waterworks, Pawtucket, R. I.; J. C. Decker, Secy., Treas. and Supt. Water Co., Salina, Kan.; A. N. Denman, Secy. Water Co., Des Moines, Ia.; J. M. Diven, Secy. and Treas. Water Co., Elmira, N. Y.; Jas. P. Donahue, Vice-Prest. and Supt. Water Co., Davenport, Ia.; H. F. Dunham, Const. Engr., Cleveland, O.; C. M. Foote, Civil Engineer, Minneapolis, Minn.; W. H. Fritchman, Supt. Water Co., Peoria, Ill.; E. W. Frost, Supt. Waterworks, Colorado Springs, Colo.; D. C. Fry, Supt. Waterworks, Jacksonville, Ill.; L. H. Gardner, Supt. Water Co., New Orleans, La.; A. J. Guilford, Mechanical Engineer, Chicago Ill.; C. A. Hague, Mec. Eng. with H. R. Worthington, New York, N. Y.; W. S. Hamilton, Superintendent Waterworks, Youngstown, Ohio; P. M. Hanley, Superintendent Waterworks, Fort Madison, Iowa; J. W. Henion, Minneapolis, Minn.; H. G. Holden, Supt. Waterworks, Nashua, N. H.; Frank W. Holly, Mechanical Engr., Lockport, N. Y.; Chas. Hood, Supt. Waterworks, Burlington, Ia.; Thomas N. Hooper, Chief Engr., Waterworks, Davenport, Ia.; George Hornung, C. E., Newport, Ky.; F. M. Jackson, Supt. Waterworks, Oak Park, Ill.; J. I. Jones; R. M. Jones, Manager Waterworks, Wyandotte, Kan.; Charles A. Judson, Supt. Waterworks, Sandusky, O.; H. E. Keeler, Director Charleston, Ill., Water Co., Chicago Ill.; W. H. Laing, Supt. Waterworks, Racine, Wis.; John T. Lakin, Supt. Waterworks, Rockford, Ill.; Albert R. Leeds, Consulting Chemist, Hoboken, N. J.; P. H. Lineen, Mechanical Engineer, Chicago, Ill.; I. L. Lyman, Commr. and Supt. Waterworks, Lincoln, Neb.; A. H. McAlpine, Chief Engineer Waterworks, Columbus, Ohio; Peter Milne, Jr., Consulting Engineer, New York, N. Y.; Wm. Molis, Supt. Water Works, Muscatine, Ia.; C. Monjeau, Hydraulic Engineer, Cincinnati, O.; A. G. Moore, Engineer and Supt. Water Dept., Cincinnati, O.; Thos. J. Neville, Water Registrar, Rochester, N. Y.; Isaac B. Potts, Mechanical Engineer, Columbus, O.; Chas. N. Priddy, Secy. and Supt. Water-Works, Leadville, Col.; W. G. Richards, Supt. Water-Works, Atlanta, Ga.; W. J. Root, Mechanical Engineer, New York, N. Y.; S. Bent Russell, Asst. Eng. Water Dept., St. Louis, Mo.; Wm. Ryle, Superintendent Water Co., Paterson, N. J.; J. P. Safford; J. T. Sawyer, President Water Co., Waverly, N. Y.; F. W. Sheppard, New York, N. Y.; W. W. Sprague, Chief Engineer Water-Works, town of Lake, Ill.; Matt. Stookey, Gen. Mgr. Water-Works, Bedlville, Ill.; Jas. A. Tilden, Mechanical Engineer, Boston, Mass.; J. Nelson Tubbs, Chief Eng. Water-Works, Rochester, N. Y., Matt Walsh, Supt. Water-Works, Minneapolis, Minn.; W. H. Watts, Supt. Water-Works, El Paso, Tex.; J. B. Wilkerson, Supt. Water-Works, Bowling Green, Ky.; W. H. Willard, Supt. Water-Works, Eau Claire, Wis.; E. S. Wilis, Supt. Water Co., Atchison, Kans.; R. D. Wirt, Supt. Water-Works, Independence, Mo.

MEMBERS ELECTED DURING PRESENT CONVENTION.

Active—R. L. Saunders, Jackson, Miss.; S. G. Artingstall, Chicago, Ill.; John H. Turner, Mobile, Ala.; Stephen A. Cabill, Manistee, Mich.; Geo. H. Pierson, New York; W. H. Glass, Covington, Ky.; R. R. Parkin, Elgin, Ill.; Joseph B. Rider, Wm. B. Rider, South Norwalk, Conn.; W. A. Alexander, Wilkensburg, Pa; Thos. H. Tracy, London, Canada; Erastus G. Smith, Beloit, Wis.; F. E. Sickles, Kansas City, Mo.; W. C. Mitchell, Janesville, Wis.; C. M. Nichols, Madison, Wis; Geo. W. Dudley, St. Louis, Mo.; Jas. R. Maxwell, Cincinnati, O.; H. S. Raymond, Chicago, Ill.; Lafe W. Straw, Danville, Ill.; Anthony P. Smith, Newark, N. J.; Joseph E. Haynes, Newark, N. J.; Z. T. Spaulding, Fort Payne, Ala.; A. D. Griffin, Frankfort, Ky.; Israel P. Rumsay, Chicago, Ill.; Ira S. Schrop, So. Bend, Ind.; Thomas W. Yardley, Chicago, Ill.; D. A. B. Bailey, Findlay, O.; N. A. Partridge, Chicago, Ill.; G. Baird, Wheeling, W. Va.; S. O. Sevier, Camden, Ark.; J. F. Alsterlund, Moline, Ill.; J. F. Sullivan, Sioux City, Ia.; W. R. Northway, Chicago, Ill.; John C. Kelley, New York; Millard F. Wright, Lowell, Mass.; George B. Wing, Kansas City, Mo.; Jas. Owen, Montclair, N. J.; Allen T. Prentice, Chicago, Ill.; C. A. Jones, Kansas City, Mo.; J. B. Page, Lynchburg, Va.; E. L. Abbott, New York; Edw. Armstrong, Allegheny Pa.; W. W. Barnard, Rochester, N. Y.; Robt. Hawkins, Chicago, Ill.; John Knickerbocker, Troy, N. Y.; J. B. Fish, Scranton, Pa.; Andrew W. Stevens, Logansport, Ind.; Robert N. Ellis, Jacksonville, Fla.; Chester B. Davis, Chicago, Ill.; M. L. Andrews, Arkansas City, Kan.; Milton A. Brown, Perth Amboy, N. J.

ASSOCIATE MEMBERS ELECTED DURING PRESENT CONVENTION.

American Filter Co., Chicago, Ill.; A. Hinds, Jr., Tuerk Hydraulic Power Co., Chicago, Ill.; Fairbanks & Co., New York; Western Valve Co., Chicago, Ill.; The A. P. Allis Co., Milwaukee, Wis.; Spiral Weld Tube Co., East Orange, N. J.; O. H. Jewell & Sons, Chicago, Ill.; Rensselaer Mfg. Co., Troy, N. Y.; Illinois Malleable Iron Co., Chicago, Ill.

EXHIBITORS.

Galvin Brass and Iron Works, Detroit, Mich.; Bourbon Copper and Brass Works, Cincinnati, O.; R. D. Wood & Co., Philadelphia; E. H. Kellogg & Co., New York; J. B. Clow & Co., Chicago; Eddy Valve Co., Waterford, N. Y.; Ludlow Valve Co., Troy, N. Y.; H. Mueller & Co., Decatur, Ill.; Fisher Governor Co., Marshalltown, Ia.; Illinois Malleable Iron Co., Chicago, Ill.; Hersey Meter Co., Boston, Mass.; Union Meter Co., Worcester, Mass.; National Meter Co., New York; Thompson Water Waste Prevention Co., New York; Western Valve Co., Chicago, Ill.; H. R. Worthington, New York; Gordon Steam Pump Co., Hamilton, O., Deane Steam Pump Co., Holyoke, Mass.; Northwestern Rubber Co., Chicago, Ill.; Tuerk Hydraulic Power Co., New York; Spiral Weld Tube Co., East Orange, N. J.; National Tube Works Co., McKeesport, Pa.; Walter S. Payne, Fostoria, O.; S. W. Morgan Mfg. Co., Buffalo, N. Y.; Jarvis B. Edson, New York; Isaac B. Potts Mfg. Co., Columbus, O.; Hayes Mfg. Co., Erie, Pa.; J. L. Mott Iron Works, New York; Rouse & Hills Co., Cleveland, O.; Rensselaer Mfg. Co., Troy, N. Y.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIII. Saturday, May 31, 1890.

D. McN. STAUFFER A. M. WELLINGTON
EDITORS.

CHAS. W. BAKER E. E. R. TRATMAN M. N. BAKER
ASSOCIATE EDITORS.

GEO. H. FROST.....BUSINESS MANAGER

SUBSCRIPTIONS.

To United States, Canada, and Mexico.

One Year, **$5.00;** *6 months,* **$2.50;** *3 months,* **$1.50;** *Single Copies, 12 cents. To all* **Foreign Countries** *(the Postal Union, add $2.08 to above prices for postage.*

CLUB RATES.

Two new subscriptions	$3.00
One renewal and one new subscription	3.00
Five new subscriptions	20.00
One renewal and four new subscriptions	20.00

Subscribers *can have the mailing address of their paper changed as often as they desire. Send both the old and the new addresses.*

The date *when the subscription expires is on the address label on each paper, the change of which to a subsequent date becomes a receipt for remittance.* **No other receipt** *is sent unless requested.*

Advertising rates, 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon;* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if those who fail to receive their papers promptly will notify us without delay.*

Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty, or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

COMING TECHNICAL MEETINGS.

Civil Engineering Society (Mass. Inst. of Technology), Boston, Mass.—Next meeting, May 29. Secy., Clement March.

Civil Engineers' Society St. Paul, Minn.—Next meeting, June 2. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting June 2. "Municipal Surveys," D. W. Pike. Secy., Kenneth Allen, 900 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, June 3. "Ferroid, an artificial stone," Dr. H. Poole. Secy., C. O. Palmer, 23 Cedar Ave.

Engineers' Club of St. Louis, Mo.—Next meeting, June 4. "Report of Committee on Collection of local data." Secy., W. H. Bryan, 309 So. 7th St.

American Society of Civil Engineers, New York.—Next meeting, June 4. Annual convention, at Cresson, Pa., in June. Secy., John Bogart, 127 E. 23d St.

Western Society of Engineers, Chicago, Ill.—Next meeting, June 4. Secy., J. W. Weston, 230 La Salle St.

Association of Civil Engineers, Dallas, Tex. Next meeting, June 6. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia, Pa.—Next meeting, June 7. Secy., Howard Murphy, 1122 Girard St.

Master Car-Builders' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 10. Secy., J. W. Cloud, Buffalo, N. Y.

Civil Engineers' Association of Kansas, Wichita, Kan.—Next meeting, June 11. Secy., J. C. Herring, Wichita.

New England Railway Club, Boston Mass.—Next meeting, June 11. Sec., F. M. Curtis, Old Colony R. R. Rooms in the United States Hotel.

New England Water-Works Association.—Annual Convention at Portland, Me., June 11, 12, 13. Secy., R. C. P. Coggeshall, New Bedford, Mass.

New York Railway Club.—Next meeting, June 12. Rooms, at 113 Liberty St.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, June 12. Secy., Olin H. Landreth, Vanderbilt University.

American Railway Master Mechanics' Association.—Annual convention at the Hygeia Hotel, Fortress Monroe, Va., June 17. Secy., Angus Sinclair, 140 Nassau St., New York.

Western Railway Club, Chicago, Ill.—Next meeting, June 17. Rooms in the Phœnix Building. Secy., W. D. Crosman.

Engineers' Society of Western Pennsylvania.—Next meeting, June 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, June 18. Secy., S. E. Tinkham, City Hall.

In the advertisement for engineers wanted in Jamaica, which appeared in these columns in recent issues, it was stated that the salary offered was £40 per month. This was an error. The actual salary offered is £25 to £30 per month.

As Decoration Day came on Friday this week, and was a holiday among pressmen, any delay in the present issue that may occur must be charged to this fact. At date of writing we do not anticipate any trouble; but we have thought best to make this explanation to cover possible contingencies.

WE publish this week some very interesting preliminary experiments for the forthcoming series of brake-shoe tests, embodying such as the committee in charge judge to be wise to make public at this time. Of the ten shoes tested, not even the materials are announced except for two shoes, a soft cast-iron and a wrought-iron shoe. But these are enough to enable certain important preliminary deductions to be drawn from these tests. The plain wrought-iron shoe shows the highest frictional efficiency *and* the least loss by wear of any of the shoes; and the plain cast-iron shoe shows almost as high efficiency as wrought-iron, with less wear than a number of others; shoes 7, 8, 9, 10, whatever they may be, show up as inferior in both of these respects. These shop tests should not be accepted as finally conclusive, however, unless and until confirmed by track tests with higher speeds, larger shoes, and perhaps, with higher unit pressures. But the probabilities are that they are a pretty correct index of what the track tests will show. We postpone further discussion till our next issue.

WE begin this week the publication of a paper by Mr. O. T. CROSBY recording what seem to be some very remarkable and noteworthy experiments in air resistance. The general laws of air resistance, we need not say, are still most imperfectly determined. If Mr. CROSBY'S experiments may be accepted as trustworthy, they have not been determined at all; for he finds, and apparently shows by experimental results, that air resistance varies neither as V^2 nor V^3, but directly as the velocity. So revolutionary a conclusion cannot be accepted without proof from tests covering a considerably wider range of areas than he has used, his tests having been almost exclusively on quite small areas. But on the other hand, his range of velocities was very great, extending from 10 to over 150 miles per hour, and his results are so consistent with each other that they at least establish a strong *prima facie* case, which demands experimental refutation before it can be thrown aside as untrustworthy. We may add that Mr. CROSBY'S conclusions, if shown to be sound, would explain certain anomalies in air resistance which have been very puzzling, while, perhaps, adding new anomalies which have not yet occurred to us. We shall hope to discuss the pros and cons of his conclusions in a later issue. The experiments were undertaken with a view to determining the best form for electrically driven cars running at very high velocities.

THERE is a vague rumor that the entire river and harbor bill may fail to pass Congress this session, owing to the possible passage of the MCKINLEY bill, with its cut of $55,000,000 in revenue from sugar duties, the $100,000,000 that is to be paid in pensions, which may be increased at least one-third by the most modest bill now before Congress, and the many other appropriations based upon a supposed "inexhaustible surplus." Any failure to pass a river and harbor bill of some kind would be disastrous in the extreme to the best interests of our country, and would only be another exhibit of that reckless and false economy too often displayed in the handling of this appropriation.

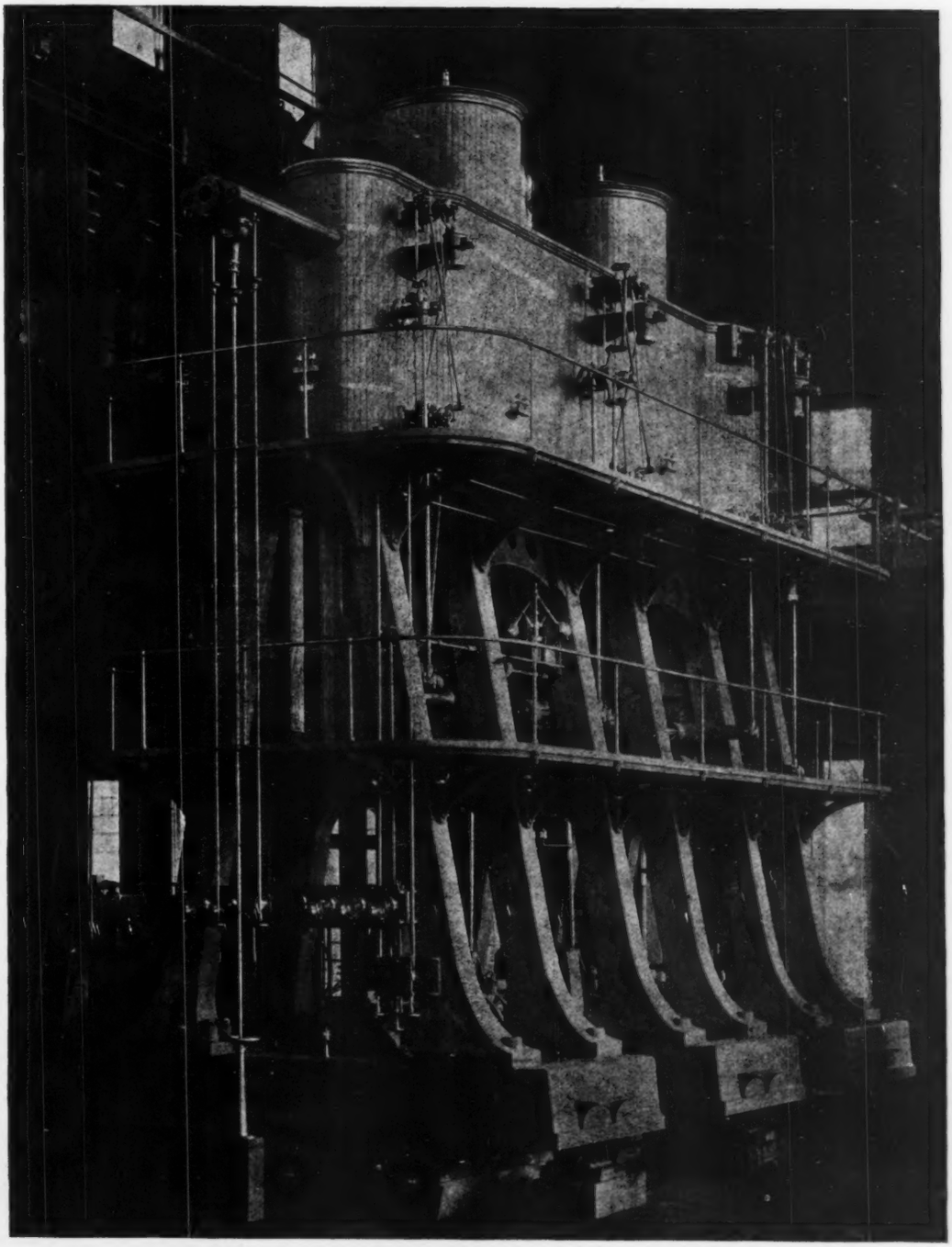
Our whole system of conducting public works needs radical and immediate overhauling, and Congress can not get at it a day too soon. The country can no longer afford to handle its affairs after the fashion of half a century ago. The times now demand the reference of all proposed public improvements to a department competent to judge of the relative merits of the various schemes, to sift the wheat out of the superabundant chaff; and when this properly organized department or board recommends certain works for execution, Congress should understand that it is wanted at once and appropriate the whole sum needed at one operation, providing for each year, until finished, a sum sufficient to speedily and economically carry it through. This present state of uncertainty concerning the completion of any enterprise of this nature commenced by the Government is prejudicial to the interests of our whole country, and our representatives in Congress should know this better than any one else, and act accordingly, even if the passage of a new law would at times involve the sacrifice of some personal interest with their several constituencies.

The Chicago Convention of American Water-Works Superintendents.

There is no doubt of a very rapid growth of interest in the construction and maintenance of water-works in this country and in the adjacent Dominion. The very large and representative body of men devoted to this special business, assembled in convention at Chicago last week, is ample evidence of this fact, while the many excellent papers read and the lively and extended discussions thereon show the earnestness of the men who find the time amid their daily duties to investigate the subjects presented, to collate their observations, and to put them at the disposal of their fellow members. The water-works superintendents who attend these meetings are very wide-awake and very matter-of-fact business men, who realise the responsibility of their positions and their duty to both their employers and the public; and the fact that they attend these meetings proves that they are earnestly attempting to learn all they can about the best method of discharging their double duty. Hence the benefit of such meetings, and the wonder is that a larger percentage of water companies and municipalities of the country has not yet waked up to the importance of this annual event in the water-works interests. But although apparently slow in realizing their duty to these organizations, the companies are beginning to see it, and we may confidently expect a very marked increase in the attendance in Philadelphia next year, and that, too, by superintendents as delegates of their employers and not at their own expense.

The convention at Chicago was eminently successful, because it had an excellent place to meet in, a good supply of papers on appropriate subjects, and was well handled by its presiding officers. The local committee had provided the most ample accommodations for all who would attend the meetings or exhibit their goods, and while considerable preparations for "junketing" had been made, yet the good sense of the members was shown in a decided vote for business before pleasure.

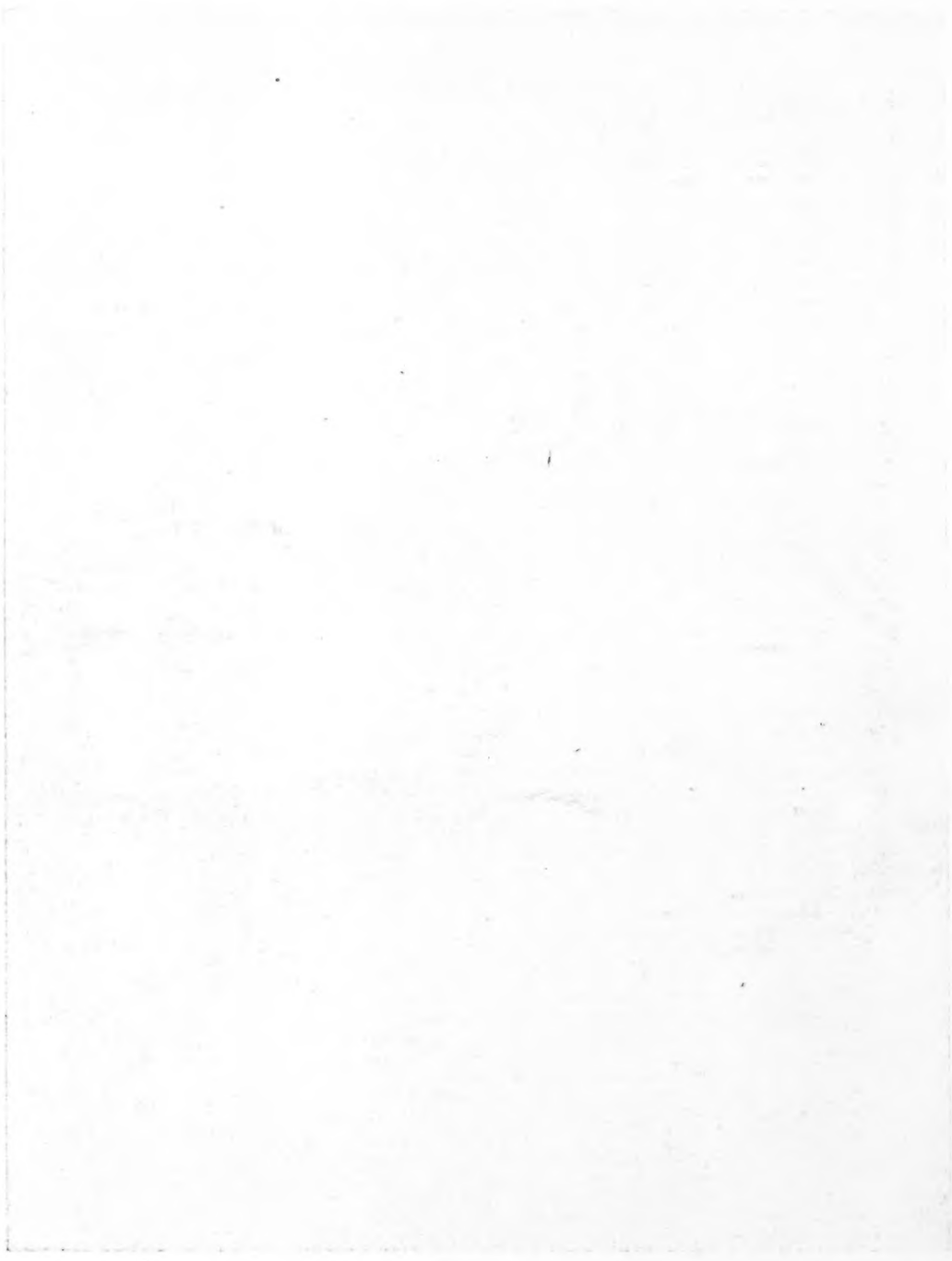
From all present indications the Philadelphia convention of next year will surpass in attendance and general interest any meeting in the history of the society. The location is favorable, the water-works interest is unusually well represented there in the form of manufactured goods, and there is much to see illustrating both good and bad practice in matters pertaining to water-works. But more than anything else that should make this meeting a success, is the growing hope that corporations and private water companies are commencing to



TRIPLE EXPANSION PUMPING ENGINE,

HARRISON ST. PUMPING STATION, CHICAGO, ILL.

EDWARD P. ALLIS CO., ENGINEERS, MILWAUKEE, WISCONSIN.



take an increased interest in the purposes of this association, and at least are beginning to realize that the growth of the association means profit to them in the better training and gain in practical knowledge on the part of their executive officers. There is scarcely a limit to the usefulness of this body of workers, when properly organized, and its membership should embrace every live man connected with water-works in any capacity throughout the whole country.

Bridge vs. Tunnel for the Hudson River.

In discussions of the project for a bridge over the Hudson River at New York City, it has been here and there assumed that the problem of crossing the river, whether by tunnel or bridge, has not been carefully studied. It is to be presumed, as a matter of course, that the railways are not in favor of costly monumental engineering works, and that they will prefer that mode of crossing the river, which to them, all other things being equal, is the best and the cheapest. We happen to know that this question of tunnel or bridge has been carefully investigated in the interest of some of the railways that would benefit by a river crossing, and that the conclusion was reached that a multiple track bridge is inevitably the cheapest solution, even though it may require a single span over the entire river. This conclusion will not be considered unfavorably by the travelling public, which invariably prefers open and airy bridges to dark and sulphurous tunnels. The fact seems plain enough that a station in New York City for tunnels would have to be underground and under the streets, with its floor near the water level, and that property must be paid for whether it is used for a viaduct or a tunnel; therefore, an elevated station, somewhat on the plan of the Broad Street Station in Philadelphia, would offer the greatest advantages.

The bridge must necessarily be large enough to let all the railways use it, and though it is intended only for passenger traffic, it may require at least six tracks to commence with, and ten tracks probably a few years afterwards. The tunnel at present building would hardly accommodate one of the ten roads terminating on the New Jersey side, much less all ten together. We have yet to hear that any one road wants to use it at all. It is as if it were attempted to carry the Mississippi River with all its tributaries to the Gulf of Mexico through a sewer or channel just large enough for one of its small tributaries. And when it is considered that ten single track tunnels would necessarily take up greater width and more property in New York City than a double-deck ten-track bridge, the greater cost of tunnels will become clear were there no other item of greater cost. If we are not mistaken all of these questions have already been studied in great detail, and, in any event, it can be assumed that the railways will eventually choose that mode of crossing the river which seems to them to be the best and the cheapest, whether it requires a monumental engineering structure or not.

We believe that tunnels under the Hudson River will be, if they are not already, a necessity between New York City and Jersey City for local travel by means of cable or electric cars. Such tunnels can necessarily be built cheaper than for heavy railway trains, and they would be unobjectionable to the public because of the absence of suffocating smoke. Several such tunnels for local rapid transit should be built between the Battery and Fourteenth St. But for the entrance of the large railways into New York from the Jersey side, a large single-span bridge appears so far to be the best and cheapest solution. The raising of forty million dollars may be as much of a formidable undertaking as the construction of the improvement itself; but as neither the government nor the cities will this time be called upon to subscribe, there appears to be no good reason why Congress should not give capital this chance to benefit the country, particularly as the proposed bridge would no more interfere with navigation on the Hudson than the clouds above it.

The Hatteras Light Contract.

In January last the Government advertised for bids for the establishment of a lighthouse on the Outer Diamond Shoal, off Cape Hatteras, under stringent and somewhat peculiar conditions; and as July 1, the time fixed for opening the bids, is drawing near it would seem proper to have something to say about this work, its nature and the conditions under which the work is to be executed.

Under the terms of the call for proposals the bidder must send complete plans and estimates, and fully describe his plans and proposed methods of erection; the successful bidder must furnish all his own material without expense to the Government; must furnish bonds in the sum of $10,000, and must complete the work and operate the light for one year before he can receive any money from the United States. In other words, the contractor must furnish all the plans and all the money needed for the work and take all the responsibility for his plans and plant and all the risks of the elements.

To those seriously contemplating bids, the proposed location of this light is most probably familiar, or at least it should be so; but for the benefit of general readers it may be described as follows: The shoal on which this light-house will be founded lies about 7½ miles east by south from the present Cape Hatteras beacon light, or the extreme point of Cape Hatteras. It is a notoriously dangerous spot, and the scene of more wrecks and more consequent loss of life than perhaps any other spot on the coast of the United States. It is so exposed that there is constantly a short, choppy sea at that point, and this will change to heavy and dangerous seas within an hour at any time. We have no data for the depth of water directly on the shoal, but there is 17 ft. on its edge. Any caisson required must necessarily be built on shore and must be towed into position; but the nearest point of access to Pamplico Sound, where such shore-work would alone be possible, is 20 miles distant from the site of the light-house.

The plant required for the successful execution of this work will be enormously expensive. A powerful, large and perfectly seaworthy steamer must be provided; one that can carry all the plant and material necessary to sink a caisson and put in, in the shortest time possible, some thousands of yards of concrete. Provision must be made for all manner of contingencies by duplicating plant and having an abundant surplus of power. This work is one of great magnitude, the most important and most difficult and dangerous of any works of its character attempted by the United States. This lighthouse must be built upon a shifting sandbank affording very bad holding ground for any kind of craft; mooring chains are also liable to be cut by the combined wave motion and sand held in suspension, and it is just possible that the caisson may land on the bones of some one of the many ships dashed to pieces on this dreaded shoal.

The moral of all this is evident, and the conditions and possible consequences should be carefully weighed, not only by the bidder but by the government officials in comparing bids. This is no case for the acceptance of the lowest tender, a cheap man or cheap work. What the government wants is a substantial, efficient and permanent light on this shoal, and the $500,000 appropriated in 1888 for this purpose is a very small item compared with the loss of property and life which has already resulted from leaving for so long a time the most dangerous bar on our coast totally unmarked.

Admiral ROWAN, President of the Lighthouse Board in 1888, in referring to this work, shows a full appreciation of the dangers and difficulties attending its successful execution, that augurs well for the consideration of bids on the part of the Board. He says in substance that the experience of the Board in making contracts with the "lowest bidder," on sufficient security, has been far from satisfactory. Some business firms, having an inadequate conception of the character of the work to be done, to commence with, bid below a fair price in the hope, that in case of failure, they can get relief from Congress. In several such cases, mentioned by Admiral ROWAN, the result was loss to the bidder and great delay to the Government in the completion of badly-needed work. In the case of certain steamers, the lowest bidders were known to be inferior workmen, but the Board was forced to accept their proposal and the consequence was, steamers just so good that the Board could not refuse to accept them and yet so poor that they have frequently been under repair since. Unfortunately, under the provision of section 4,667 of the Revised Statutes, the Board has no option, but must give the contract to the lowest bidder, if the security is sufficient and satisfactory. The Treasury Department so decided in the case of the metal work for the Fowey Rocks light-house, though the insufficiency of the plant of the lowest bidder was submitted to the Secretary. The Department cannot afford to repeat this experience in the case of the Hatteras Light.

There are only a very few firms in the United States who have the expert skill, the necessary experience, abundant capital and plant and the trained assistants absolutely required in this case, and who lastly have a reputation to risk; and competition should be, if possible, confined to these firms, but there are contractors who will recklessly rush in where wiser men fear to tread, and if the door is left open to men of this latter character, failure is inevitable and delay in a much-needed public work is certain. It is for this reason, mainly, that the Lighthouse Board has made such stringent and seemingly unfair conditions connected with this work, and only propose to pay for a finished and thoroughly tested structure. The government seems disposed to pay fairly well, and work done under these conditions should be well paid for; for even under the best management and with the wisest precautions, the elements cannot be controlled and one or two caissons may be totally lost before the foundation is a success. The erection of this lighthouse has been pronounced by those most likely to know, a very dangerous but a feasible enterprise, and one requiring much special skill and experience in the contractor. And as proving that it is feasible, if well handled, Admiral ROWAN and other officers of the Board refer to the fourteen-foot Delaware Bay light as an example, where "a little less skill, a trifle less power, a slight deficiency in experience would have made the work a disastrous failure instead of a gratifying success."

For the reputation and the profit of the Government it is to be hoped that means will be found to confine the bids to contractors of known skill, experience, and capital, and to these men alone. And we advise would-be bidders, who cannot fully meet these requirements, to stand off entirely, for their failure will be certain; and the Government should make it plainly understood before-hand that no relief or aid of any kind is to be expected, or will be given. The Government should not, and can not afford to pay in time for the experiments and chances of any man; the best man only is good enough, and success in present and past work of a similar nature is the only safe standard of fitness.

CORRESPONDENCE.

Finding Depth of Half-Area of Trapezoidal Section.

BALTIMORE, Md., May 26, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: If the cross-section on page 498 of your last issue were given to me to find the vertical depth of the water, I would apply the following method:

The total area = 47.5 sq. ft.

Area of required section = half of this, or 23.75 sq. ft.

The two parts are necessarily similar, therefore:

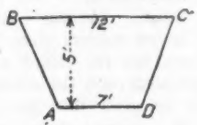
$12^2 + 7^2 = 193$. Half of this = $\sqrt{96.5} = 9.82 +$ ft., or width at x.

Half of $9.82 + 7.0 = 8\ 41$.

$23.75 \div 8.41 = 2.824$ ft., or y.

$5. - 2.824 = 2.176$ ft., or z.

G. W. CUNARD,
Sr. Asst. Engr. B. & D. P. R. R.
MILFORD, Mass., May 27, 1890.



TO THE EDITOR OF ENGINEERING NEWS:

SIR: I submit the following as being at least a briefer solution than that of Mr. MICHAEL (in your issue of May 24, 1890).

Let x = No. feet depth from bottom up to contain half the area of the above section. As the increase is one horizontal to one vertical

$$(7 + 7 + x)\frac{x}{2} = \frac{\text{area of whole trapezoid}}{2}$$

$$= \frac{7 + 12}{4} \times 5.$$

Solving the quadratic equation:

$x = 2.824$—the required depth.

J. N. DARLING.

Mr. S. W. FRESCOLM, of Reading, Pa., sends the following:

Take the example given, employing Fig. 3:

$B \times = h$ = req. depth.

$$\frac{h}{G \times} = \frac{5}{2\,5} = \frac{2}{1}$$

$$G \times = \frac{h}{2}$$

$$G H = 7 + h$$

$$\frac{h}{2}(14 + h) = 23.75 = \text{half area.}$$

$$h^2 + 14\,h = 47.5$$

$$h = 2.824 \text{ ft.}$$

[All of the above solutions of this very simple problem are very much neater than that which originally appeared, and which must have crept into the paper while the editor was meditating on his vanishing chances of a summer vacation.—ED. ENG. NEWS.]

A Successful Car-Coupler Test.

PHILADELPHIA, May 26, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: A very interesting and in many respects remarkable test of the efficiency of automatic cushioned car-couplers was made on May 16, 1890, at Wayne Junction, under the direction of the officials of the Philadelphia & Reading R. R. Co. It was witnessed by a large number of officials, representing other companies, engineers and others.

The coupler so tested is known as the Van Dorston Cushioned Car-Coupler, and has recently been adopted by the Reading company, covering 4,000 freight cars.

The coupler is of the type adopted by the Master Car Builders' Association. The remarkable feature of the test consisted in the facility with which cars were coupled one to another when the train was moving at a speed of not less than 10 to 12 miles an hour, and upon sharp curves. Under such speed and momentum there was but little concussion, the shock being taken up and compensated by the perfectly rubber-cushioned couplers.

It is not the object of the writer to describe in detail the test above referred to, which enlisted great interest, but rather to commend the wisdom and progressive policy of the present management of the Reading company, in abandoning the old link and pin coupler, a relic of barbarism, and substituting the automatic or self coupler.

In the interest of human life, to say nothing of true economy and comfort, it is to be hoped that self couplers of some class or type will soon wholly displace the link and pin on every railway, for the use of the latter has been a most fruitful source of injury to life and limb of railway employés. WM. BARNET LE VAN.

[We would not detract from our correspondent's doubtless well-deserved compliment to the officials of the Reading; but it strikes us that in this day and generation a company is not so much deserving of credit for adopting automatic couplers as of discredit for not doing so.—ED. ENG. NEWS.]

The Water-Works of Ypsilanti, Mich.

YPSILANTI, MICH., May 21, 1890.

EDITOR ENGINEERING NEWS:

SIR: I am highly pleased with your full, fair and frank editorial comments in the last issue upon my paper describing the Ypsilanti Water Works. My aim in preparing this paper for our State Engineering Society was to call the attention of the profession to what I consider very radical defects in the prevalent modes of water-works construction, and, if possible, to contribute something that will lead to better work and better results.

For the last ten years, in my professional work, I have been trying to impress upon municipal boards, and upon the profession, the importance and need of radical changes in the popular methods in vogue in the building and operation of water-works systems. So little success attended my efforts in this direction as to convince me that nothing short of a full, practical, working demonstration would ever effect the desired result. Consequently I began in Ypsilanti one year ago, determined to furnish a full, practical working model in the interest not only of Ypsilanti, but of the entire country, to demonstrate the correctness of my views.

I feel that the success here has been well nigh perfect in all its practical features, and the result fully carries out all that I have ever claimed for the system. Yet I am far from being satisfied even with this result; the work has cost 10% more than necessary, and there are some ugly looking things about the tower and pumping works that ought not to exist and would not have been made had not the engineer been interfered with. Truth compels me to admit that primarily the fault for all this belongs to me, for had I taken a firm position in the outset, as was my duty, the Board would have sustained me and all these faults would have been avoided. The cost of the Ypsilanti works is lower, notwithstanding all this, than it would have been had contracts been let all through; but had all other branches of the work been under as efficient committee management as was the street-main system, the entire work would have been in better shape than now and, as before said, would have cost 10% less money on the whole, or 25% less on the parts affected.

On the whole, Ypsilanti has had the best Board of Water Commissioners it has ever been my good fortune to work with. On more than one occasion the work would have come to a dead stop but for the public spirit and generosity of the president of the board and the chairman of the Finance Committee, who several times came to the rescue when the city was out of funds, and paid bills of $25,000 and $30,000 from their own pockets, and thus kept the work going on with no delay to the finish.

But while as a whole this board is of high excellence, yet the added cost and the few ugly features named above are entirely due to the theoretical and experimental vagaries, and the usurpations of authority to carry them out, of one of the members of this otherwise unrivalled board.

The large cost of our elevated reservoir, if unexplained, would serve to frighten many small cities otherwise desiring such a structure. This structure cost 45% more than was necessary, and the architectural effect is inferior. Our power pumps and building changes ought to have cost but $4,000 in place of the $10,000 which they did cost. In other words, the Ypsilanti water works have cost 10% more money than they would have cost had the engineer been entirely free from interference, and this extra cost has impaired, rather than improved, the beauty and efficiency of the work as a whole.

A stronger illustration could not be brought forward to emphasize your advice that engineers should be honest and true to themselves and their calling, and that municipal boards should employ only competent and honest engineers to whom to intrust their public work, and when once employed should give them full authority and hold them fully responsible.

My paper was chiefly designed to apply to small cities and those of medium size, but I see not the slightest reason why the principle should not work equally well in the largest cities, by simply dividing them into districts, and putting an elevated reservoir of adequate size in each. Take a city of 100,000 population for example, and put up ten reservoirs of one million galls. capacity each. These reservoirs can be all in full communication throughout the entire street main distribution. (There will be no serious difficulty in maintaining a satisfactory equilibrium between them.) Such structures could be made very prominent and beautiful features in any landscape, and they would immensely promote the efficiency of the water service in all its branches. I fully agree with you in the propriety and economy of continuous pumping in large plants; but I do insist upon a reserve which will admit of short stoppages of the pumps without stopping the whole service, and I do most emphatically protest against the variable pressure pumping system. W. R. COATS.

A Standard Method of Conducting Duty Trials of Pumping Engines.*

(*Continued from Page* 474.)

The following examples are given to illustrate the method of computation. The figures are not obtained from tests actually made, but they correspond in round numbers with those which were so obtained:

First example.—Compound tandem direct-acting duplex engine. Both high-pressure and low-pressure cylinders jacketed with live steam. Jet condenser used, with air-pump driven by main engine. Boiler feed-pump also driven by main engine. Jacket water returned to boiler by gravity. Main supply of feed-water drawn from hot well.

DIMENSIONS.	
Diameter of each high pressure cylinder (two)	15 ins.
Diameter of each low-pressure cylinder (two)	30 "
Diameter of piston-rod, each cylinder (one at each end H. P., two at one end L. P.)	3.5 "
Diameter of pump plungers (two)	15 "
Diameter of piston-rod, each plunger (one at one end)	3.5 "
Nominal stroke	18 "
GENERAL DATA.	
1. Duration of test (D)	12 hrs.
2. Boiler pressure by gauge (barometric pressure 14.7 lbs.)	120 lbs.
3. Temperature of water in pump well	80°
4. Temperature of main supply of feed-water	100°
5. Temperature of jacket water	280°
6. Percentage of moisture in steam	0%
7. Weight of water supplied to boiler by main feed-pump	22,400 lbs.
8. Weight of water supplied to boiler by jackets	2,560 "
DATA RELATING TO WORK OF PUMP.	
9. Area of plunger minus ¼ area of rod (A)	171.9 sq. ins.
10. Average length of stroke (L and L_s)	1.572 ft.
11. Total number of single strokes during trial (N and N_s)	76,000.
12. Pressure by gauge on force main (P)	100 lbs.
13. Vacuum by gauge on suction main	9.3 ins.
14. Pressure corresponding to vacuum given in preceding line (p)	4.57 lbs.
15. Vertical distance between guages	8 ft.
16. Pressure corresponding to distance given in preceding line (s)	3.46 lbs.
17. Volume of water which leaked through the plungers computed from results of leakage test (C)	5,900 cu. ft.
DATA RELATING TO WORK OF STEAM CYLINDERS.	
18. Area of high-pressure piston minus area of one rod (A_s)	167.09 sq. ins.
19. Mean effective pressure high-pressure cylinder ($M.E.P._1$)	61.31 lbs.
20. Area of low-pressure piston minus ½ area of two rods (As_2)	697.24 sq. ins.
21. Mean effective pressure low-pressure cylinder ($M.E.P._2$)	13.72 lbs.
22. Number of double strokes each side per minute	26.39
23. Indicated horse power developed by steam cylinders	99.61 I. H. P.
24. Feed-water consumed per indicated horse power per hour	20.88 lbs.
25. Heat units consumed per indicated horse power per hour	23,008 B. T. U.
=383 B. T. U. per minute.	
TOTAL HEAT OF STEAM RECKONED FROM THE VARIOUS TEMPERATURES OF FEED-WATER AND COMPUTATIONS BASED THEREON.	
26. Total heat of 1 lb. of dry steam at 120 lbs. gauge-pressure reckoned from 0° Fahr.	1,220.6 B.T.U.
27. Ditto, reckoned from temperature of main feed-water 100°	1,120.5 "
28. Ditto, reckoned from temperature of jacket-water (280°)	938.5 "
29. Heat consumed by engine (H) (22,400 × 1120.5) + (2560 × 938.5)	27,501,760 "

RESULTS.

Substituting these quantities in the formulæ, we have:

1. Duty =

$$\frac{\frac{A}{171.9} \times (\frac{P}{100} + \frac{p}{4.57} + \frac{s}{3.46}) \times \frac{L}{1.572} \times \frac{N}{76,000}}{\frac{H}{27,501,760}} \times 1,000,000$$

= 80,671,622 foot pounds.

2. Percentage of leakage =

$$\frac{\frac{C}{5,900 \times 144}}{\frac{A}{171.9} \times \frac{L}{1.572} \times \frac{N}{76,000}} \times 100 = 4.1\%$$

3. Capacity = $\dfrac{\frac{A}{171.9} \times \frac{L}{1.572} \times \frac{N}{76,000} \times 1.24675}{\frac{D}{12}}$

= 2,133,735 gallons.

4. Percentage of total frictions =

$$\left[1 - \frac{\frac{A}{171.9} \times (\frac{P}{100} + \frac{p}{4.57} + \frac{s}{3.46})}{\frac{As_1}{(167.09} \times \frac{M.E.P._1}{61.31)} + \frac{As_2}{(697.24} \times \frac{M.E.P._2}{13.72)}}\right] \times 100 = 9.4\%.$$

Second Example.—Compound fly-wheel engine. High-pressure cylinder jacketed with live steam from the boiler. Low-pressure cylinder jacketed with steam from the intermediate receiver, the condensed water from which is returned to the boiler by means of a pump operated by the engine. Main steam-pipe fitted with a separator. The intermediate receiver provided with a reheater supplied with boiler steam. Water drained from high-pressure jacket, separator, an reheater, collected in a closed tank under boiler pressure, and from this point fed to the boiler direct by an independent steam-pump. Jet condenser used operated by an independent air-pump. Main supply of feed-water drawn from hot well and fed to the boiler by a donkey steam-pump, which discharges through a feed-water heater. All the steam pumps, to-

* Committee report to the American Society of Mechanical Engineers at the Cincinnati meeting of May, 1890.

gether with the independent air-pump, exhaust through the heater to the atmosphere.

DIMENSIONS.

Diameter of high-pressure steam cylinder (one)	20 ins.
Diameter of low-pressure steam cylinder (one)	40 "
Diameter of plunger (one)	20 "
Diameter of each piston rod	4 "
Stroke of steam pistons and pump plunger	3 ft.

GENERAL DATA.

1.	Duration of trial (D)	10 hrs.
2.	Boiler pressure indicated by gauge (barometric pressure, 14.7 lbs.)	120 lbs.
3.	Temperature of water in pump well	60 degs.
4.	Temperature of water supplied to boiler by main feed-pump leaving heater	215 "
5.	Temperature of water supplied by low-pressure jacket pump	225 "
6.	Temperature of water supplied by high-pressure jacket, separator and reheater pump, that derived from separator being 340°, and that from jackets 290°	300 "
7.	Weight of water supplied to boiler by main feed-pump	18,863 lbs.
8.	Weight of water supplied by low-pressure jacket pump	615 "
9.	Weight of water supplied by pump for high-pressure jacket, separator and reheater tank, of which 210 lbs. is derived from separator	1,925 "
10.	Total weight of feed-water supplied from all sources	20,503 "
11.	Percentage of moisture in steam after leaving separator	1.5%

DATA RELATING TO WORK OF PUMP.

12	Area of plunger minus ½ area of piston-rod (A)	307.88 sq. ins.
13.	Average length of stroke (L and L_s)	3 ft.
14.	Total number of single strokes during trial (N and N_s)	24,000
15.	Pressure by gauge on force main (P)	95 lbs.
16.	Vacuum by gauge on suction main	7.5 ins.
17.	Pressure corresponding to vacuum given in preceding line (p)	3.69 lbs.
18.	Vertical distance between centers of two gauges	10 ft.
19.	Pressure equivalent to distance between two gauges (s)	4.33 lbs.
20.	Total leakage of pump during trial, determined from results of leakage test (C)	3,078 cu. ft.
21.	Number of double strokes of pump per minute	20
22.	Mean effective pressure measured from pump diagrams	105 lbs.
23.	Indicated horse power exerted in pump cylinders	117.55 I.H.P.

DATA RELATING TO WORK OF STEAM CYLINDERS.

24.	Area of high-pressure piston minus ½ area of rod (As_1)	307.88 sq. ins.
25.	Area of low-pressure piston minus ½ area of rod (As_2)	1,250.36 "
26.	Average length of stroke, each	3 ft.
27.	Mean effective pressure measured from high-pressure diagrams ($M.E.P._1$)	59.25 lbs.
28.	Mean effective pressure measured from low-pressure diagrams ($M.E.P._2$)	13.60 lbs.
29.	Number of double strokes per minute (line 21)	20
30.	Indicated horse power developed by H. P. cylinder	66.33 I.H.P.
31.	Indicated horse power developed by L. P. cylinder	61.82 "
32.	Indicated horse power developed by both cylinders	128.15 "
33.	Feed-water consumed by plant per indicated horse power per hour, corrected for separator water and for moisture in steam	15.60 lbs.
34.	Number of heat units consumed per indicated horse power per hour	15,652.1 B.T.U.
35.	Number of heat units consumed per indicated horse power per minute	260.9 "

TOTAL HEAT OF STEAM RECKONED FROM THE VARIOUS TEMPERATURES OF FEED-WATER AND COMPUTATIONS BASED THEREON.

36.	Total heat of 1 lb. of steam at 120 lbs. gauge pressure, containing 1.5% of moisture, reckoned from 0 degrees F. = 1,220.6 − (1.5% of 866.7)	1,207.6 B.T.U.
37.	Ditto, reckoned from 215 degrees, temperature of main feed-water = 1,207.6 − 215.9	991.7 "
38.	Ditto, reckoned from 225 degrees, temperature of low-pressure jacket water = 1,207.6 − 226.1	981.5 "
39.	Ditto, reckoned from 290 degrees, temperature of high-pressure jacket and reheater water = 1,207.6 − 292.3 =	915.3 "
40.	Heat of separator water reckoned from 340 degrees, = 353.9 − 343.8 =	10.1 "
41.	Heat consumed by engine (H) = (18,863 × 991.7) + (615 × 981.5) + (815 × 915.3) + (210 × 10.1) =	20,058,150 "

RESULTS.

Substituting these quantities in the formulæ, we have:

1. Duty $= \frac{A \times P \quad p \quad s \quad L \quad N}{307.88 \times (95 + 3.69 + 4.33) \times 3 \times 24{,}000} \times 1{,}000{,}000$

$\frac{}{H}$

$\frac{}{20{,}058{,}150}$

$= 113{,}853{,}944$ foot pounds.

2. Percentage of leakage $= \frac{C}{3{,}078 \times 144} \times 100 = 2.0\%$

$\frac{}{A \quad L \quad N}$

$\frac{}{307.88 \times 3 \times 24{,}000}$

3. Capacity $= \frac{A \quad L \quad N}{307.88 \times 3 \times 24{,}000 \times 1.24675}$

$\frac{}{D}$

$\frac{}{10}$

$= 2{,}763{,}716$ gallons.

4. Percentage of total frictions

$$= \left[1 - \frac{\frac{A}{307.88} \times (95 + \frac{p}{3.69} + \frac{s}{4.33})}{\frac{As_1}{307.88} \times \frac{M.E.P._1}{50.25} + \frac{As_2}{1250.36} \times \frac{M.E.P._2}{13.6}} \right] \times 100$$

$= 9.0\%$

8. The method to be followed in conducting the boiler test, which is recommended, is the standard mode determined upon by the society's Committee on Boiler Trials.* It is suggested that the results of the boiler test be expressed, not only in terms of the number of pounds of water evaporated per pound of coal, in the customary manner, but also in terms of the number of pounds of coal required to generate 1,000,000 heat-units, so that a simple calculation may determine the duty of the engine, if desired, on the basis of 100 lbs. of the coal actually used.

9. In order that the contract between builder and purchaser of a pumping engine may conform to the proposed standard, the guarantee as to performance should be expressed in the following terms:

1. The engine shall perform a duty, based upon plunger displacement, equivalent to not less than ..... foot-pounds of work for each 1,000,000 heat-units consumed.

2. The leakage of the pump shall not exceed ..... per cent. of the total plunger displacement, when the engine is working at its rated capacity.

3. The boiler shall supply 1,000,000 heat-units to the engine on a consumption of ..... pounds of ..... coal, or it shall evaporate not less than ..... pounds of water from and at 212° per pound of the combustible portion of the coal named.

4. The mode of determining these quantities is to conform to the standard method of conducting duty trials, recommended by the Committee of the American Society of Mechanical Engineers.

Should one contractor furnish the engine, and another the boiler, separate guarantees will be made, the individual requirements of which are the same as those noted.

It is desirable, where both parties concur therein, to introduce into the contract the following additional provision regarding friction, viz.:

The friction of the engine shall not exceed .... per cent. of the indicated power developed in the steam cylinders.

10. Having thus far noted the main principles which have been followed, and having pointed out the various steps by which the results of a test are computed, the committee now beg to submit, in the following pages, the full particulars regarding the standard method of conducting duty trials, which they recommend.

The general mode of operation is to first subject the plant to a preliminary run under the working conditions, for the purpose of determining the temperature of the feed water, or the several temperatures where there is more than one supply. It is usually impracticable to weigh the main supply of water, derived, as it generally is, from a low-placed hot-well, and the test of the main quantity of feed-water used must, as a rule, be made with cold water drawn from the service main. The changed conditions in the working of the plant, thus introduced, and the arrangement of apparatus which is frequently needed to measure the additional supplies of feed-water, make it desirable to obtain the working temperatures as a preliminary to the main duty trial. Hence the preliminary run is made, as noted, merely for securing the temperatures. The main test of the boiler and engine is then carried forward, and during this test the weights of the various supplies of feed-water are determined, and the remaining data needed for making the computations. Finally, as soon as practicable after these tests are completed, the rate of leakage through the pump is measured, with the engine at rest.

As to the duration of the test, it appears to the committee that, so far as the main trial is concerned, which is practically a feed-water test, it need not be prolonged more than 10 hours, unless, in that time, appreciable errors should be produced by inaccuracies in the observations of the height of water in the gauge glass. The duration of the boiler trial might, with good reason, be made longer, were it not that the results of the boiler test are independent of those of the duty trial. It is desirable to reduce, if possible, the number of hours of the trial to such a point that the time expended upon the work, including that required in preparation for the beginning of the test, and that spent in bringing the test to a close, shall be such that the same expert, without undue physical exertion, may have the test under his continuous supervision from beginning to end. This is feasible, where the length of the duty trial, according to the plan proposed, does not exceed ten hours.

Shortly after the committee were appointed several pumping-engine manufacturers were asked to submit their ideas as to the best form of standard to use. The committee take pleasure in acknowledging the receipt of suggestions from the Davidson Steam Pump Co., the Deane Steam Pump Co., the Holly Manufacturing Co., and the George F. Blake Manufacturing Co., the three last named having given full expression to their views upon the subject. Respectfully submitted,

GEO. H. BARRUS,
A. F. NAGLE,
EDWIN REYNOLDS,
J. J. DE KINDER,
J. S. COON,
} *Committee.*

[Extracts from the appendices will be given next week —ED.]

Standard Method of Conducting Duty Trials.

1. TEST OF FEED-WATER TEMPERATURES.

The plant is subjected to a preliminary run, under the conditions determined upon for the test, for a period of three hours, or such a time as is necessary to find the temperature of the feed-water (or the several temperatures, if there is more than one supply) for use in the calculation of the duty. During this test observations of the temperature are made every fifteen minutes. Frequent observations are also made of the speed, length of stroke, indication of water-pressure gauges and other instruments, so as to have a record of the general conditions under which this test is made.

DIRECTIONS FOR OBTAINING FEED-WATER TEMPERATURES.

When the feed-water is all supplied by one feeding instrument, the temperature to be found is that of the water in the feed-pipe near the point where it enters the boiler. If the water is fed by an injector this temperature is to be corrected for the heat added to the water by the injector, and for this purpose the temperature of the water entering and of that leaving the injector are both observed. If the water does not pass through a heater on its way to the boiler (that is, that form of heater which depends upon the rejected heat of the engine, such as that contained in the exhaust steam either of the main cylinders or of the auxiliary pumps) it is sufficient for practical purposes, to take the temperature of the water at the source of supply, whether the feeding instrument is a pump or an injector.

When there are two independent sources of feed-water supply, one the main supply from the hot well, or from some other source, and the other an auxiliary supply derived from the water condensed in the jackets of the main engine and in the live steam reheater, if one be used, they are to be treated independently. The remarks already made apply to the first, or main supply. The temperature of the auxiliary supply, if carried by an independent pipe either direct to the boiler or to the main feed-pipe near the boiler, is to be taken at convenient points in the independent pipe.

When a separator is used in the main steam-pipe, arranged so as to discharge the entrained water back into the boiler by gravity, no account need be made of the temperature of the water thus returned. Should it discharge either into the atmosphere to waste, to the hot well, or to the jacket tank, its temperature is to be determined at the point where the water leaves the separator before its pressure is reduced.

When a separator is used, and it drains by gravity into the jacket tank, this tank being subjected to boiler pressure, the temperature of the separator water and jacket water are each to be taken before their entrance to the tank.

Should there be any other independent supply of water, the temperature of that is also to be taken on this preliminary test.

DIRECTIONS FOR MEASUREMENT OF FEED WATER.

As soon as the feed-water temperatures have been obtained the engine is stopped, and the necessary apparatus arranged for determining the weight of the feed-water consumed, or of the various supplies of feed-water, if there is more than one.

In order that the main supply of feed-water may be measured, it will generally be found desirable to draw it from the cold-water service main. The best form of apparatus for weighing the water consists of two tanks, one of which rests upon a platform scale supported by staging, while the other is placed underneath. The water is drawn from the service main into the upper tank, where it is weighed, and it is then emptied into the lower tank. The lower tank serves as a reservoir, and to this the suction-pipe of the feeding apparatus is connected.

The jacket water may be measured by using a pair of small barrels, one being filled while the other is being weighed and emptied. This water, after being measured, may be thrown away, the loss being made up by the main feed-pump. To prevent evaporation from the water, and consequent loss on account of its highly heated condition, each barrel should be partially filled with cold water previously to using it for collecting the jacket water, and the weight of this water treated as tare.

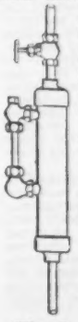


Fig. 1.

When the jacket water drains back by gravity to the boiler, waste of live steam during the weighing should be prevented by providing a small vertical chamber, and conducting the water into this receptacle before its escape. A glass water-gauge is attached, so as to show the height of water inside the chamber, and this serves as a guide in regulating the discharge valve. The chamber may be made of piping in the manner shown in the appended Fig. 1.

When the jacket water is returned to the boiler by means of a pump, the discharge valve should be throttled during the test, so that the pump may work against its usual pressure, that is, the boiler pressure as nearly as may be, a gauge being attached to the discharge pipe for this purpose.

When a separator is used and the entrained water discharges either to waste, to the hot well, or to the jacket tank, the weight of this water is to be determined, the water being drawn into barrels in the manner pointed out for measuring the jacket water. Except in the case where the separator discharges into the jacket tank, the entrained water thus found is treated, in the calculations, in the same manner as moisture shown by the calorimeter test. When it discharges into the jacket tank, its weight is simply subtracted from the total weight of water fed, and allowance made for heat of this water lost by radiation between separator and tank.

When the jackets are drained by a trap, and the condensed water goes either to waste or to the hot-well, the determination of the quantity used is not necessary to the main object of the duty trial, because the main feed-pump in such cases supplies all the feed-water. For the sake of having complete data, however, it is desirable that this water be measured, whatever the use to which it is applied.

Should live steam be used for reheating the steam in the intermediate receiver, it is desirable to separate this from the jacket steam, if it drain into the same tank, and measure it independently. This, likewise, is not essential to the main object of the duty trial, though useful for purposes of information.

The remarks as to the manner of preventing losses of live steam and of evaporation, in the measurement of jacket water, apply to the measurement of any other hot water under pressure, which may be used for feed-water.

Should there be any other independent supply of water to the boiler, besides those named, its quantity is to be determined independently, apparatus for those measure-

* Vol. VI., p. 267, *Transactions A. S. M. E.*, 1885.

ments being set up during the interval between the preliminary run and the main trial, when the plant is idle.

2. THE MAIN DUTY TRIAL.

The duty trial is here assumed to apply to a complete plant, embracing a test of the performance of the boiler, as well as that of the engine. The test of the two will go on simultaneously after both are started, but the boiler test will begin a short time in advance of the commencement of the engine test, and continue a short time after the engine test is finished. The mode of procedure is as follows:

The plant having been worked for a suitable time under normal conditions, the fire is burned down to a low point and the engine brought to rest. The fire remaining on the grate is then quickly hauled, the furnace cleaned and the refuse withdrawn from the ashpit. The boiler test is now started, and this test is made in accordance with the rules for a standard method recommended by the Committee on Boiler Tests of the American Society of Mechanical Engineers.* This method, briefly described, consists in starting the test with a new fire lighted with wood, the boiler having previously been heated to its normal working degree; operating the boiler in accordance with the conditions determined upon; weighing coal, ashes and feed-water; observing the draught, temperatures of feed-water and escaping gases, and such other data as may be incidentally desired; determining the quantity of moisture in the coal and in the steam; and at the close of the test hauling the fire, and deducting from the weight of coal fired whatever unburned coal is contained in the refuse withdrawn from the furnace, the quantity of water in the boiler and the steam pressure being the same as at the time of lighting the fire at the beginning of the test.

Previously to the close of the test it is desirable that the fire should be burned down to a low point, so that the unburned coal withdrawn may be in a nearly consumed state. The temperature of the feed-water is observed at the point where the water leaves the engine heater, if this be used, or at the point where it enters the flue heater, if that apparatus be employed. Where an injector is used for supplying the water, a deduction is to be made in either case for the increase t temperature of the water derived from the steam which it consumes.

As soon after the beginning of the boiler test as practicable the engine is started and preparations are made for the beginning of the engine test. The formal commencement of this test is delayed till the plant is again in normal working condition, which should not be over one hour after the time of lighting the fire. When the time for commencement arrives the feed-water is momentarily shut off, and the water in the lower tank is brought to a mark. Observations are then made of the number of tanks of water thus far supplied, the height of water in the gauge-glass of the boiler, the indication of the counter on the engine, and the time of day; after which the supply of feed-water is renewed, and the regular observations of the test, including the measurement of the auxiliary supplies of feed-water, are commenced. The engine test is to continue at least 10 hours. At its expiration the feed-pump is again momentarily stopped, care having been taken to have the water slightly higher than at the start, and the water in the lower tank is brought to the mark. When the water in the gauge-glass has settled to the point which it occupied at the beginning, the time of day and the indication of the counter are observed, together with the number of tanks of water thus far supplied, and the engine test is held to be finished. The engine continues to run after this time till the fire reaches a condition for hauling, and completing the boiler test. It is then stopped, and the final observations relating to the boiler test are taken.

The observations to be made and data obtained for the purposes of the engine test, or duty trial proper, embrace the weight of feed-water supplied by the main feeding apparatus, that of the water drained from the jackets, and any other water which is ordinarily supplied to the boiler, determined in the manner pointed out. They also embrace the number of hours duration, and number of single strokes of the pump during the test; and, in direct-acting engines, the length of the stroke; together with the indications of the gauges attached to the force and suction mains, and indicator diagrams from the steam cylinders. It is desirable that pump diagrams also be obtained.

Observations of the length of stroke, in the case of direct-acting engines, should be made every five minutes; observations of the water-pressure gauges every fifteen minutes; observations of the remaining instruments, such as steam gauge, vacuum gauge, thermometer in pump well, thermometer in feed pipe, thermometer showing temperature of engine room, boiler room, and outside air, thermometer in flue, thermometer in steam pipe, if the boiler has steam heating surface, barometer, and other instruments which may be used, every half hour. Indicator diagrams should be taken every half hour.

When the duty trial embraces simply a test of the engine, apart from the boiler, the course of procedure will be the same as that described, excepting that the fires will not be hauled, and the special observations relating to the performance of the boiler will not be taken.

DIRECTIONS REGARDING ARRANGEMENT AND USE OF INSTRUMENTS AND OTHER PROVISIONS FOR THE TEST.

The gauge attached to the force main is liable to a considerable amount of fluctuation unless the gauge-cock is nearly closed. The practice of choking the cock is objectionable. The difficulty may be satisfactorily overcome, and a nearly steady indication secured, with cock wide open, if a small reservoir, having an air-chamber, is interposed between the gauge and the force main, in the manner shown in the appended

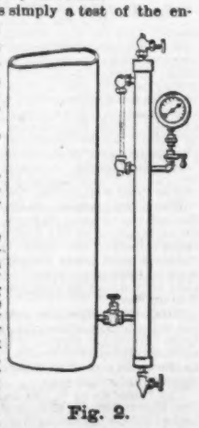


Fig. 2.

Fig. 2. By means of a gauge-glass on the side of the chamber and an air-valve, the average water-level may be adjusted to the height of the center of the gauge, and correction for this element of variation is avoided. If not thus adjusted the reading is to be referred to the level shown, whatever this may be.

To determine the length of stroke in the case of direct acting engines, a scale should be securely fastened to the frame which connects the steam and water cylinders, in a position parallel to the piston-rod, and a pointer attached to the rod so as to move back and forth over the graduations on the scale. The marks on the scale, which the pointer reaches at the two ends of the stroke, are thus readily observed, and the distance moved over computed. If the length of the stroke can be determined by the use of some form of registering apparatus, such a method of measurement is preferred. The personal errors in observing the exact scale marks, which are liable to creep in, may thereby be avoided.

The form of calorimeter to be used for testing the quality of the steam is left to the decision of the person who conducts the trial. It is preferred that some form of continuous calorimeter be used, which acts directly on the moisture tested. If either the super-heating calorimeter* or the wire-drawing† instruments be employed, the steam which it discharges is to be measured either by numerous short trials, made by condensing it in a barrel of water previously weighed, thereby obtaining the rate by which it is discharged, or by passing it through a surface condenser of some simple construction, and measuring the whole quantity consumed. When neither of these instruments is at hand, and dependence must be placed upon the barrel calorimeter, scales should be used which are sensitive to a change in weight of a small fraction of a pound, and thermometers which may be read to tenths of a degree. The pipe which supplies the calorimeter should be thoroughly warmed and drained just previous to each test. In making the calculations the specific heat of the material of the barrel or tank should be taken into account, whether this be of metal or of wood.

If the steam is superheated, or if the boiler is provided with steam-heating surface, the temperature of the steam is to be taken by means of a high-grade thermometer resting in a cup holding oil or mercury, which is screwed into the steam-pipe so as to be surrounded by the current of steam. The temperature of the feed-water is preferably taken by means of a cup screwed into the feed-pipe in the same manner.

Indicator pipes and connections used for the water cylinders should be of ample size, and, so far as possible, free from bends. Three-quarter-inch pipes are preferred, and the indicators should be attached one at each end of the cylinder. It should be remembered that indicator springs which are correct under steam heat are erroneous when used for cold water. When such springs are used the actual scale should be determined, if calculations are made of the indicated work done in the water-cylinders. The scale of steam springs should be determined by a comparison, under steam pressure, with an accurate steam-gauge at the time of the trial, and that of water springs by cold dead-weight test.

The accuracy of all the gauges should be carefully verified by comparison with a reliable mercury column. Similar verification should be made of the thermometers, and if no standard is at hand they should be tested in boiling water and melting ice.

To avoid errors in conducting the test, due to leakage of stop-valves either on the steam pipes, feed-water pipes, or blow-off pipes all these pipes not concerned in the operation of the plant under test should be disconnected.

3.—LEAKAGE TEST OF PUMP.

As soon as practicable after the completion of the main trial (or at some time immediately preceding the trial), the engine is brought to rest, and the rate determined at which leakage takes place through the plunger and valves of the pump, when these are subjected to the full pressure of the force main.

The leakage of the plunger is most satisfactorily determined by making the test with the cylinder head removed. A wide board or plank may be temporarily bolted to the lower part of the end of the cylinder, so as to hold back the water in the manner of a dam, and an opening made in the temporary head thus provided for the reception of an overflow pipe. The plunger is blocked at some intermediate point in the stroke (or, if this position is not practicable, at the end of the stroke), and the water from the force main is admitted at full pressure behind it. The leakage escapes through the overflow pipe, and it is collected in barrels and measured.

Should the escape of the water into the engine room be objectionable, a spout may be constructed to carry it out of the building. Where the leakage is too great to be readily measured in barrels, or where other objections arise, resort may be had to weir or orifice measurement, the weir or orifice taking the place of the overflow pipe in the wooden head. The apparatus may be constructed, if desired, in a somewhat rude manner, and yet be sufficiently accurate for practical requirements. The test should be made, if possible, with the plunger in various positions.

In the case of a pump so planned that it is difficult to remove the cylinder head, it may be desirable to take the leakage from one of the openings which are provided for the inspection of the suction valves, the head being allowed to remain in place.

It is here assumed that there is a practical absence of valve leakage, a condition of things which ought to be attained in all well-constructed pumps. Examination for such leakage should be made first of all, and if it occurs and it is found to be due to disordered valves, it should be remedied before making the plunger test. Leakage of the discharge valves will be shown by water passing down into the empty cylinder at either end when they are under pressure. Leakage of the suction valves will be shown by the disappearance of water which covers them.

If valve leakage is found which cannot be remedied, the quantity of water thus lost should also be tested. The determination of the quantity which leaks through the suction valves, where there is no gate in the suction pipe, must be made by indirect means. One method is to measure the amount of water required to maintain a certain pressure in the pump-cylinder when this is introduced through a pipe temporarily erected, no water being allowed to enter through the discharge valves of the pump.

The exact methods to be followed in any particular case, in determining leakage, must be left to the judgment and ingenuity of the person conducting the test.

A form for a Table of Data and Results follows, which we omit.

A Universal Steam Calorimeter.*

In one of the discussions† at the last meeting the author introduced a brief notice of what he has named "A Universal Calorimeter," and he made the statement that at a future meeting he would describe the instrument more in detail, and give the results of some experimental work upon it, in connection with evaporative trials of boilers, and this he now proposes to do.

In experimenting with the author's superheating calorimeter,‡ where the quality of steam was being tried, which was very wet and almost beyond the range of the apparatus, a device was planned, though never perfected, for passing the steam first through a chamber in which some of the moisture would be deposited, and thus relieve the instrument from handling so much water, thereby increasing its range. It may be mentioned that the use of such a device in connection with the superheating form of instrument will enable any desired amount of moisture to be measured by that instrument, and overcome the objection of limited range which has been raised against it.

This method of treating a part of the moisture in wet steam, where the quantity is excessive, has been perfected in the apparatus now brought to notice, but in place of using a superheating calorimeter for determining the remaining quantity of moisture, recourse has been had to the wire-drawing principle, the application of which to calorimeter work formed the subject of Prof. PEABODY'S paper at the Scranton meeting.§

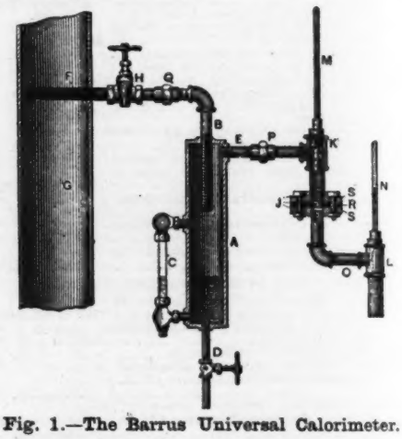


Fig. 1.—The Barrus Universal Calorimeter.

The appended cut (Fig. 1), shows the apparatus. The principal parts of the instrument consist of the chamber *A*, or "drip-box," as it is called, and the "heat-gauge," consisting of the orifice *I*, and the two thermometers *M* and *N*. The instrument is connected to the main steam-pipe *G* which carries the steam to be tested, by means of the perforated pipe *F*, and this pipe extends across the full diameter, in order to obtain a sample of the steam tested. The orifice *I* opens into a pipe which is in free communication with the atmosphere. By the use of the orifice a continuous current of steam is made to pass through the whole apparatus, and the current has a constant rate so long as the pressure is constant. In the form thus far made, the supply-pipe *F*, and the fittings, up to the drip-box, are the ordinary size of ¼-in. steam-pipe. The drip-box is 2 ins. inside diameter and 12 ins. long, and the drain-pipe *D* is ¼-in. pipe. The pipe leaving the drip-box is also ¼-in., and the remaining pipes and fittings are of the ¾-in. size. The parts marked *S*, which inclose a plate in which the orifice is placed, are a pair of union flanges, and inserted between these flanges and under the bolt-heads are pieces of non-conducting material which prevent the direct transfer of heat through the metal walls of the high-pressure pipe above the orifice to the walls of the low-pressure pipe below it. The thermometer *M* rests in an oil-cup, *K*, as shown, and the thermometer *N* is arranged in a like manner.

The use of the non-conducting material shown at the points *J*, might seem to some unnecessary, and it may be explained that in some early experiments with the superheating calorimeter it was found absolutely necessary to cut off all solid metallic connection between the jacket and the interior heating pipe, else there would be a transfer of heat from one to the other, which would make the indications of the thermometers erroneous. The same principle applies here, and justifies the arrangement which has been adopted.

The orifice *I* is made about ⅛ in. in diameter for pressures in the neighborhood of 80 lbs.; and under 80 lbs. pressure it discharges about 60 lbs. weight of steam per hour.

---

*Vo. VI., p. 267, *Transactions A. S. M. E.*, 1885.

* Vol. VII., p. 178, 1886.

† Vol. XI., p. , 1890, *Transactions A. S. M. E.* (Paper on "A Universal Calorimeter," May, 1890).

*A paper by GEO. H. BARRUS, read at the Cincinnati Meeting of the American Society of Mechanical Engineers

†*Transactions* A. S. M. E., Vol. XI., page 205.

‡*Transactions* A. S. M. E., Vol. VII., page 178: Vol. VIII., page 235.

§*Transactions* A. S. M. E., Vol. X., page 327, Paper No. 325.

The range of the wire-drawing part of the instrument or "heat-gauge," as it has been named, is a percentage of moisture varying according to the pressure. When this is 80 lbs., the range is between 3% and 4%. It is unnecessary to use the drip-box unless the quantity of moisture is in excess of, say, 3%. The unions *P* and *Q* are therefore made interchangeable. When a test is to be made, the heat-gauge is first applied directly to the union *Q* and a preliminary trial made, to see what the general condition of the steam is. Whenever the moisture exceeds 3%, or the limiting quantity at the existing pressure, the thermometer *N* shows a temperature of about 213°, and drops of water will generally be seen escaping from the open discharge-pipe. If the quantity of moisture is not beyond the range of the wire-drawing instrument, the temperature shown by thermometer *N* will be in excess of 213°.

It is generally advisable to bring the complete apparatus into use, if the thermometer *N* shows less than 220°. It is usually found, when the steam is wet enough to show this latter temperature, that the quantity of moisture varies, and thermometer *N* fluctuates over a considerable range, and at times it will drop to its limit of 213°. Whenever, therefore, thermometer *N* shows a temperature of 213°, either continuously or periodically, it is necessary to bring the drip-box into use.

In using the complete apparatus, the condensed water from the drip-box is drawn off, by means of the valve *D*, into a bucket resting on scales, and the quantity drawn off is regulated so as to keep the water level, as shown in the glass *C*, at a constant point. When the drip-box is used in this way, the author has found that almost the whole quantity of moisture in a sample will be deposited here, and very little moisture will be left to pass over into the heat-gauge. Indeed, the experiments show that the drip-box alone, with a suitable orifice or valve provided at the top, so as to obtain a proper circulation through it, would form a very satisfactory instrument for determining the quantity of moisture, in any case where the steam contained much of it.

When the quantity of moisture drawn off from the drain-valve *D* has been determined for a given time, the percentage of moisture which this represents must be found by comparing it with the total amount of steam passing through the apparatus. The total may be determined either by computation or by trial. The computation may be made by finding the exact area of the orifice, and computing the quantity which passes through by means of the formula,

$$Q = \frac{\text{Pressure above zero} \times \text{area}}{70},$$

which gives the number of pounds discharged through the orifice per second. The pressure to be used is that corresponding to the temperature shown by the thermometer *M*. The quantity, as thus found, is accurate enough for rough comparisons. The exact quantity can be determined by conducting the steam discharged from the open end of the apparatus into a tube of water placed on scales,—or, what is a better way, into a coil of lead-pipe, or iron-pipe, surrounded by flowing water, in the manner of a surface condenser, and weighing the condensed water drawn off in a given time.

A certain amount of moisture is produced by radiation from the apparatus itself, even though all the parts are well covered, as it is quite necessary that they should be, with hair felting. The readings of the instrument on the test must therefore be corrected for the loss thus occasioned. It has been the practice of the author to make these corrections by observing the indications when the apparatus is supplied with steam from the pipe *G*, at a time when the pressure is steady and the pipe contains nothing but dead steam, there being no current. This condition of things can generally be obtained in a factory at noon-time, when the engine is stopped, or at night, after the close of the day's work. It may fairly be presumed that the apparatus is then supplied with dry steam, and whatever moisture collects in the drip-box *A*, and whatever difference is shown by thermometers *M* and *N*, is due simply to the loss of heat from radiation. When the loss from radiation has been thus obtained, the quantity representing that due to the drip-box is simply subtracted from the weight of water drawn off during the same length of time on the main test. The way in which the correction is applied to the readings of thermometers *M* and *N* is to take the reading of thermometer *N* on the radiation test when thermometer *M* indicates an average, and use this reading as a starting-point. The indication of thermometer *N* on the main test is then simply subtracted from this normal reading. For example, suppose the average reading of the upper thermometer (*M*) during the main test is 312°; suppose the lower thermometer (*N*) indicates an average of 260° on the main test, and on the radiation trial suppose it indicates 267° when thermometer *M* shows 312°; the process would be simply to subtract 260 from 267, and this would give as a result 7° as the cooling effect produced by the moist steam discharged on the main test.

In order to compute the amount of moisture from the loss of temperature shown by the heat-gauge, the number of degrees of cooling of the lower thermometer (*N*) is divided by a certain coefficient, representing the number of degrees of cooling due to 1% of moisture. This coefficient depends upon the specific heat of superheated steam, which, according to REGNAULT'S experiments, is 0.48. In other words, the heat represented by 1° of superheating is 0.48 of a thermal unit. The author's experiments show that this quantity cannot be applied exactly to the form of instrument under consideration. The quantity to be used varies somewhat according to the degree of moisture. For an instrument working under a temperature of 314°, by the upper thermometer, and with a cooling by the lower thermometer from 268° to 241°, the quantity was found to be about 0.42. When the cooling, however, was from 266° to 225°, the quantity to be used was found to be about 0.51. The experiments have not as yet covered a sufficient range to determine the exact law which can be applied to every case, but it seems probable that the specific heat is more or less constant until the temperature by the lower thermometer approaches the point of saturation for the low-pressure steam, while beyond this point the specific heat rapidly increases. For the present, it is assumed that the quantity 0.42 is the proper one to apply whenever the temperature by the lower thermometer is above 235°, and that in cases where the temperature is below 235°, the quantity to be used is an increasing one, reaching perhaps to 0.55 when the temperature drops to 220°.

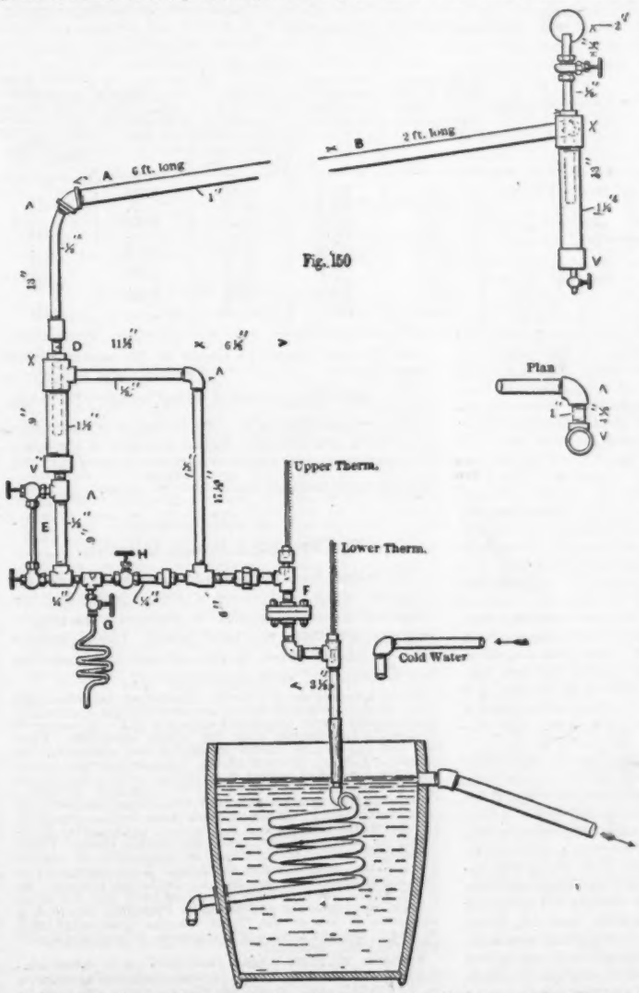


Fig. 2.—Apparatus for Determining the Coefficient of the Barrus Calorimeter.

One per cent. of moisture, now, represents the quantity of heat determined by multiplying the latent heat of one pound of steam, having a pressure corresponding to the indication of thermometer *M*, by 0.01, and this product is to be divided by 0.42 (provided the lower temperature is not below 235°), in order to express it in terms of degrees of superheat. For example: When thermometer *M* shows 312°, the latent heat is 894 thermal units, and 1% of this is 8.94; dividing by 0.42, the number of degrees of superheat corresponding to 1% of moisture is found to be 21.3. For several other temperatures, which cover the ordinary range that would commonly be used, the necessary coefficient is given in the following table:

Temperature by Thermometer *M*.	Coefficient.	Temperature by Thermometer *M*.	Coefficient.
270	22.0	320	21.1
280	21.8	330	21.0
290	21.7	340	20.8
300	21.5	350	20.6
310	21.3	360	20.5

The author then gave a description of several tests made with the calorimeter, which we briefly abstract as follows:

Test No. 1.—Plain tubular boiler with large steam drum. Quality of steam fluctuated greatly and rapidly from nearly dry to very wet, the latter being its state just after boiler was fired. The "heat gauge" was used alone and showed moisture in the steam as high as 4.34%.

Test No. 2.—Cast-iron sectional boiler used for steam heating. New, but had been used a considerable time without blowing off. Complete calorimeter was used. Drip box alone showed moisture from 0.17% to 10%. The average total moisture in the steam in the steam was 3.75%. A second test was made after the boiler had been blown off and refilled, and showed but 0.53% of moisture in the steam.

Test No. 3.—Water-tube boiler, heat gauge alone used. Moisture in steam, 0.68%.

Test No. 4.—Water-tube boiler. Calorimeter readings taken at 1 to 5 minute intervals during a 10-hours run. Moisture, 1.48% to 0.048%.

Test No. 5.—Plant of 4 horizontal return tubular boilers. Very little variation in moisture; average was 0.19%.

Test No. 6.—Plant of 11 horizontal return tubular boilers. Average moisture in steam = 1.17%.

Test No. 7.—Two horizontal return tubular boilers.

The author makes the following note:

> Considerable interest attaches to this test on account of the priming of one of the boilers, which was brought about by design. This boiler was filled with water to nearly the top of the glass, and the bituminous coal fire was barred up, the damper opened wide, and the boiler made to do its maximum amount of work. The time when this occurred was 2.05 P. M., and shortly afterward the quantity of water collecting in the drip-box began to increase, and for the seven and a half minutes between 2.15 and 2.22½, 18.9 ounces of water were withdrawn. This represents 9.28 lbs. per hour, or about 18.5% of moisture, the quantity of steam used being estimated at 50 lbs. per hour.
>
> Taking the ordinary indications of the instrument during the 20 minutes' time between 12.55 and 1.15 P. M., the drip-box discharged 2.7 ounces, or 0.51 of a pound per hour. The average reading of the upper thermometer was 304.9°, and of the lower thermometer, 268.2°. Comparing these observations with the normal readings, it is seen that there was but a trifling indication of moisture.
>
> It may be added that the priming was found to be due when the water was carried too high, to the presence of vegetable matter in the water, and to too infrequent blowing off.

Test No. 8.—*Determination of the Coefficient and Test of the Accuracy of the Heat-gauge.*—The series of experiments which the author has made to determine the proper coefficient to be used in estimating the percentage of moisture from the readings of the thermometers in the heat-guage have not, as already stated, been made sufficiently complete thoroughly to settle the quantities for all conditions; but, so far they have been completed, they are believed to be reliable, and applicable to this form of instrument within the range of operations chosen. The idea which has been worked out was to conduct the steam to the calorimeter through a certain amount of piping, which, by the loss of heat due to radiation, would produce a certain constant rate of moisture. This was first drawn off from the drip box and its quantity determined. It was then conducted into the heat gauge, and the effect of this upon the thermometers was observed.

The apparatus used is shown in Fig. 2. The drip-box

is represented at *E*, and the heat gauge at *F*, and the two valves *G* and *H* were provided, the former to draw off the moisture from the drip-box, and the latter to carry the moisture into the heat gauge. Following back to the right-hand end of the figure, the steam is taken first from a horizontal 2-in. pipe, which was supplying, during most of the experiments, an engine, and during the remaining ones it carried off a sufficient quantity of steam to produce a proper circulation. It dropped vertically through a ½-in. pipe into a well, from the bottom of which an open pet-cock discharged any water of condensation carried along with the steam. This well was made of 1½-in. pipe; from the top of the well an inch pipe, 8 ft. long, inclined so as to drop 14 ins., carried the steam to a ½-in. pipe at the left, which, in turn, supplied the top of the drip-box; the bottom of the drip-box was provided with the glass attachment shown, which is a slightly different arrangement from that shown in the drawing at the opening of the paper, although it answers the same purpose. The lower end was connected, through a series of tees, valves, and unions, to the entrance of the heat-gauge *F*. From the top of the drip-box a ½ in. pipe was carried to the heat-gauge, being joined at an intermediate point between the valve *H* and the upper thermometer. The drip-box proper was made of 1¼ in. pipe, and the various sizes of fittings used and the dimensions are indicated in the sketch. On leaving the heat-gauge the steam was conducted through a rubber tube into a coil of iron pipe placed in a barrel, and the outlet of the coil discharged through the side of the barrel to the atmosphere. A current of cold water was passed through the barrel, around the coil, and emptied to waste. Attached to the vent of the drip-box was a coil of ¼-in. pipe, which was covered with wet cotton-waste, the object of which was to keep the heated water which was discharged through the valve from re-evaporating. The apparatus was all thoroughly covered with hair felting, and on one series of tests the whole of the pipe *A B* was covered, while on another series the part marked *A* was covered and the part marked *B* was bare. The felting was three-quarters of an inch thick.

The method of carrying on the test was to first allow the moisture which entered the drip-box to escape from the valve *G* directly into the atmosphere, the valve *H* being shut. The level of the water was maintained at a fixed point in the glass; readings of the two thermometers were taken every two or two and a half minutes, and the quantity of water drawn off at *G*, as also that which was discharged through the condensing coil, was measured every five or six minutes. The test was usually continued for about one hour's time; some of the tests, however, being of 30 minutes duration. The first test having been completed, the valve *G* was shut and the valve *H* opened, and the test was continued with no other change of conditions. The opening of the valve *H* was regulated so as to keep the height of water in the glass at the same point as on the preceding test.

The average results of the various tests which have thus far been made are given in the appended table.

TESTS OF COEFFICIENT OF HEAT-GAUGE.

Test No.	Moisture discharged through.	Supply-pipe, covered.	Duration.	Temperature by upper thermometer, deg.	Temperature by lower thermometer, deg.	Weight of steam, including moisture passing through orifice, per hour, lbs.	Weight of water drawn from drip-box per hour, lbs.	Specific heat as applied to the instrument, calculated from foregoing data, lbs.
a	Drip-valve	Wholly.	1 hour.	312.4	265.4	53.87	0.644	.....
	Heat-gauge	"	1 "	312.2	239.6	53.89	.....	0.415
b	Drip-valve	"	2 "	312.5	267.0	53.58	0.684	.....
	Heat-gauge	"	2 "	313.8	241.4	54.97	.....	0.414
c	Drip-valve	Partly.	1 "	313.6	266.4	53.94	1.284	.....
	Heat-gauge	"	1 "	313.1	225.0	54.40	.....	0.514
d	Drip-valve	"	30 min	314.1	277.2	54.50	1.350	.....
	Heat-gauge	"	30 "	314.1	223 9	55.32	.....	0 511
e	Drip-valve	"	1 hour.	314.3	267.9	55.00	1.309	.....
	Heat-gauge	"	1 "	314.3	227.1	55.82	.....	0.519

The method of computing the specific heat from the results of the experiments is as follows: Suppose, for the sake of clearness, that the steam has a temperature of 312° by the upper thermometer, the total heat of which, if dry, is 1,209.1 thermal units; suppose, also, that the normal by the lower thermometer for this temperature, for absolutely dry steam passing by the upper thermometer, is 283°. Let *C* represent the actual proportion of moisture entered in the heat gauge, and *k* the specific heat of the super-heated steam which is to be found. We have now, for the total heat of the steam entering the heat gauge 1,209.1—(*C*×894.2), the quantity 894.2 being the latent heat of steam of this temperature. Suppose now, for simplicity, that the steam issuing from the heat-gauge is at a pressure of the atmosphere, and that *T* represents the actual temperature of the issuing steam, as shown by the lower thermometer; then the total heat of this issuing steam is given by the expression, $1{,}178.5 + k\ (T - 212)$. Assuming no loss by radiation, these two quantities are equal; in other words, $1{,}209.1 - (C \times 894.2) = 1{,}178.5 + k\ (T - 212)$. We may substitute for 1,209.1 its equivalent—that is, $1{,}178.5 + k\ (283 - 212)$, and we shall then have the following equation: $1{,}178.5 + k\ (283 - 212) - (C \times 894.2) = 1{,}178.5 + k\ (T - 212)$. Reducing and transposing, $k\ (283 - T) = C \times 894.2$; from which we have the equation, $k = \frac{C \times 894.2}{283 - T}$. This equation is true for any other percentage of moisture, *c*, and its corresponding temperature by the lower thermometer, *t*; so that, to apply the equation to the exact case under consideration, the specific heat would be found from the final equation, $k = \frac{(C - c)\ 894.2}{T - t}$. The quantity in the parenthesis $C - c$ is the proportion of moisture corresponding to the water which, on one experiment, is drawn off from the drip box, and on the other experiment carried through the heat gauge. To show the method of computation, take test No. *a*: The first experiment shows that the quantity of water drawn off from the drip box is 0.644 lb. per hour. It is presumed that this quantity represents the moisture going into the heat gauge on the second test, when the total quantity of steam and moisture passing into the heat gauge, as shown by the condensing coil was 53.89 lbs. per hour. The proportion of moisture is $\frac{0.644}{53.89} = 0.0119$; this, multiplied by 894., which is the latent heat corresponding to 312.2° by the upper thermometer, gives 10.64. The difference in the readings of the lower thermometers on the two tests is 265.4° − 239.6° = 25.8°. The specific heat of the steam, then, is $\frac{10.64}{25.8} = 0.41$.

The Brooklyn Bridge Question.

The action had in regard to the Brooklyn Bridge question since the failure of the bill to abolish the Board of Trustees can best be shown by the following extracts from the local press. These extracts are now nearly three weeks old, but the situation has not changed since they appeared:

Brooklyn Standard-Union. — President HOWELL and those of the Bridge trustees who act with him apparently learned nothing by the recent agitation in the newspapers and in the Legislature over the bridge extension. They are not apparently moved at all by the wishes of the people. A bare quorum of the trustees—eleven out of twenty—yesterday passed a resolution asking for the appointment of two experts, one to be appointed by Mayor GRANT and one by Mayor CHAPIN, who, in conjunction with Engineer MARTIN, should prepare plans for the extension of the bridge railway and for certain ornamental structures to be erected as stations and storage sheds. These experts, according to the terms of the resolution, are not given power to determine anything. They are simply to prepare plans and submit them to the bridge trustees. In other words, the men who have managed the bridge so that, according to the admission of President HOWELL, a trip over it now at the "rush" hours is attended with danger to life and limb, are to continue to work their will with the great structure.

Engineer MARTIN, whose published plans were condemned as dangerous by the highest engineering opinion in the country, says he has drawings already prepared to submit to the experts as soon as they are appointed. They may be the old tail switching plans pronounced "murderous" by some engineers of high repute, or they may be entirely new plans, but the one thing certain is that they will conform to the land lines which Mr. HOWELL and his friends think best suited to their purposes. No other plans would be accepted by the President of the Board of Trustees. Possibly they may be all right. The chances are, however, the other way. But why should the people be put to the expense of paying two additional engineers whose plans must conform to Mr. HOWELL'S preconceived notion of how the bridge extension ought to be made, and how far finally it ought to extend?

Brooklyn Eagle.—This resolution is a concession in a degree to public opinion. It is an admission to the necessity of taking action on the question involved or a realization of the policy of seeming to take action. Whether the Mayor of Brooklyn and the Mayor of New York will consent to appoint the experts proposed can alone be determined by their response to the idea, when it is officially communicated to them. The project differs from one which sounded like it in the bill which was urged by the Mayor of Brooklyn on the Legislature. In that bill the selection of three experts was provided for, but the engineer of the bridge, Mr. MARTIN, refused to be one of them, and realized the impropriety of his acting in that capacity, because the whole difficulty has grown out of the fact that he is the author of a special plan of which the trustees have become the marked partisans. Under the Mayor's bill, Mr MARTIN would not have been one of this proposed board. Under the resolutions, if they are carried out, he will be. If the idea of his identification as a party in interest with the proposed board was improper at Albany and in a bill before the Legislature, it is improper in Brooklyn and in resolutions passed by the fellow partisans of his pet plan of the Board of Trustees. In the Mayor's bill it was also provided that the proposed board of three experts, of whom none should be parties in interest to some special plan, should unanimously agree to any result before that result should be considered as final. In the resolution of the Board on Monday no such unanimous agreement is required. If the proposed board should be constituted Mr. MARTIN, as the author of a plan which must be supposed to be inadequate because it has never been effected, would have one vote, and he would need only to secure the vote of another expert in order to have his ideas adopted. If they were adopted, the probability is that they would not be fruitful of any practical results, and this probability arises from the fact that Mr. MARTIN'S plan, as it is called, was solemnly and formally adopted, over two years ago, and nothing has been done in pursuance of that action yet.

According to the Mayor's bill, the unanimous agreement of a board of disinterested experts was to be binding on the Board of Trustees, who were required only to render a perfunctory approval of them and then to carry them out. By the resolutions of Monday a disinterested board of experts would not be secured, a unanimous agreement, even of an interested board, would not be required, and the conclusions even of a majority of them, far from being binding on the Board of Trustees, would not be so little as reported to that body, until and unless they had passed through the shaping hands of the Committee on Terminal Facilities. It would rest with that committee to adopt, reject or modify the conclusions. It would rest with the Board of Trustees to adopt, reject or modify any report which the committee might make, and then it would rest with the same board to delay, defer, expedite or indefinitely to hang up any report they might receive from their committee. Finally, it would rest with Engineer MARTIN himself to execute, non-execute, retard, push, procrastinate or alter any such plans of which the carrying out will devolve on him. We think it will be seen that under the cover of a seeming purpose to conciliate public opinion, the trustees have surrounded the subject with such possibilities of evasion or nullification as will be far from reassuring to the people of these two cities.

Nearly every paper in New York, and every paper in Brooklyn, has commented on this proposed action in similar terms. It is now three weeks since this action was had, and the mayor of Brooklyn has as yet made no appointment. Mayor GRANT, of New York, made an excellent appointment on May 27, Mr. SAMUEL SPENSER, ex-President of the Baltimore & Ohio R. R., and a man of very long and extended railway experience, and now of the banking firm of Drexel, Morgan & Co.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Philadelphia & Seashore.—This road, running from Winslow to Sea Isle City, N. J., 35 miles, is rapidly nearing completion. The Philadelphia & Reading R. R. Co., which will operate the new line, is having a full complement of new rolling stock constructed.

Baltimore & Ohio.—A press dispatch from Philadelphia, Pa., says:

There is no longer any doubt that the Baltimore & Ohio Railroad Co will extend southward and connect with the Richmond & West Point Terminal Railway system, placing the Philadelphia & Reading in connection with the great railroads of the South. It is also stated that Senator Calvin S. Brice, who is one of the Richmond Terminal Directors, will become a Director in the Baltimore & Ohio. The Metropolitan Southern Railway Co. has been incorporated in Maryland by the officers of the Baltimore & Ohio. The new road will be built from Linden Station on the Baltimore & Ohio, nine miles from the southern boundary of the State of Maryland, and to a narrow point on the Potomac River. It will place the Baltimore & Ohio in communication with the Virginia Midland Railroad, which is part of the Richmond & West Point Terminal system. This will bring the Philadelphia & Reading into close relations with a company operating 7,300 miles of rail and water lines, from which it will get a valuable freight and passenger traffic.

Ohio Valley.—Work has begun on the 15-mile section of the proposed extension from Bellaire to Marietta, O., the contracts for which were recently let. This section is to be completed by Oct. 1, and it is expected that contracts for the remainder of the line will be let soon and that the entire 84 miles will be completed by Jan. 1, 1891. The road will follow the bank of the river closely and pass through a rich farming section. There will be considerable heavy work on the line, which is estimated to cost about $1,700,000.

Kentucky & Indiana Bridge Co.—This company has purchased the New Albany Belt & Terminal railway, which is projected to form a belt line transfer at the city of New Albany, Ind. The line is now under construction and will be completed in about three months.

Evansville & Terre Haute—A press despatch says:

The Mackey people have abandoned the Evansville & Richmond project, which has cost about $50,000. The programme now is to build the extension from Anderson to Rushville, Ind., and then consolidate, under a new name, the Cincinnati, Wabash & Michigan, the Rushville & Greensburg, the Vernon, Greensburg & Rushville and the Evansville & Richmond lines, of all of which D. J. Mackey will be president.

Maine Central.—Wm. A. Allen, of Portland, Me., Chief Engineer, writes us as follows:

The proposed extension of the Upper Coos Railroad will run from North Stratford, Vt., via. Brunswick, Maidstone and Guildhall, Vt., and Lancaster and Jefferson, N. H., to Hazens Junction, N. H., a total distance of 33 miles, of which 12 miles are in Vermont, and 21 miles in New Hampshire. There will be one large bridge. Surveys are now in progress. D. Williams is the engineer in charge of construction.

Projects and Surveys.

Columbus & Chicago Air Line.—This company has been chartered to build a railway through the State of Ohio. The company has also filed papers of incorporation with the secretary State of Indiana for the building of the road through that State, and an engineer's corps will be

gin work at once. The preliminary steps have been taken in Ohio and an engineer's corps will soon be on the line. The road in Ohio will pass through the counties, of Franklin, Madison, Champaign, Miami, Shelby, Darke and Mercer, where it reaches the State line, and will be taken up by the Indiana contingent. The stock-books will be opened at once at Sidney, Urbana and Columbus. The original stock for surveys in Ohio is $10,000.

Montpelier & Chicago. —A press dispatch from Detroit, Mich., dated May 22, says:

To-day surveyors have started on a preliminary survey of a new railroad route straight west from Montpelier, Ohio, to Chicago, which will make the shortest line from Detroit to that city. Ample funds have been secured to construct the road, which will reach an estimated maximum cost of $2,500,000. When the line is completed it will belong to the Wabash R. R., although it is surmised that the Canadian Pacific is one of the backers of the project, and will make use of it. This route lies nearly in a straight line west from Montpelier, through Northern Ohio and Northern Indiana, until Lake Michigan is approached, when it deflects northerly to reach Chicago. The Wabash is built from Detroit to Montpelier, which is a station on the Butler Road, as the Detroit connection of the Wabash is called. When completed the new line will extend 150 miles from Montpelier, and make a continuous line of 272 miles from Detroit, which is shorter by 13 miles than the line of the Michigan Central.

Lake Winnepesaukee.—A project is on foot to build a railway up into the Franconia and White Mountains-New Hampshire. The road will run along the south shore of Lake Winnepesaukee, and connect at Alton Bay with the Boston & Maine R. R.

Northern Indiana.—Chartered in Indiana to build a railway from South Bend to Mishawaka, Ind. Among the incorporators are: Wm. Miller, J. W. Vanderbosch, Wm. McIron, John T. Clark and Wm. G. George.

Georges Valley.—Preparations are being made to let the contract for this Maine road at an early date. The road is projected to run from Warren to Union Common, eight miles. Henry A. Hancox, of Hudson, Mass., is Chief Engineer.

SOUTHERN. Existing Roads.

East Tennessee, Virginia & Georgia.—It is announced that work will be commenced at once upon the proposed line from Hazlehurst to Way Cross, Ga., a distance of 40 miles.—Purdy & Rexford, of New York City, who have the contract for the line from Johnson City to Embreville, Tenn., are sub-letting the contract. The work is to be pushed as rapidly as possible.

Southern & Western Air Line.—The contract for building this North Carolina railway has been let to S. D. Dunavant. The road is to run from Shelby to Cranberry, N. C., about 100 miles, and of this distance 23 miles have been partly graded. A mortgage has been negotiated to the Central Trust Co., of New York City, for $1,500,000 of bonds to secure the the money necessary to construct the line.

Paducah, Tennessee & Alabama.—Johnson & Co., of St. Louis, Mo., the contractors, have commenced work on the section from Paducah to the Tennessee State line. The road is projected to run from Paducah, Ky., via Paris, Tenn, to Florence, Ala. The division from Paducah to Paris will be built first.

Georgia Southern & Florida.—It is announced that this company has secured terminal facilities at St. Petersburg, Fla., and will at once take steps to extend its line to that point. The company proposes to secure the Palatka & Lake Weir and the Ocala & Gulf railways by purchase and complete the gaps.

Wilmington, Onslow & East Carolina.—Tracklaying on this road has reached a point 10 miles east of Wilmington, and will soon be completed to Scott's Hill A large quantity of rails has arrived at Wilmington from New York, and the tracklaying will be pushed as rapidly as possible.

Norfolk & Western.—This company has sold $2,000,000 of its proposed new issue of stock. The money is to be used in double-tracking about 50 miles of the line, and other additions, improvements, and extensions made necessary by the completion of the connection with the Louisville & Nashville R. R.

Roanoke & Southern.—This company is asking bids for the construction of a three-span iron truss bridge over Smith river. The contract has been let for the two-span girder bridge over the Mayo river. G. W. Moslin, of Winston-Salem, N. C., is General Superintendent.

Nashville, Chattanooga & St. Louis.—It it stated to be the intention of this company to complete the Tennessee & Coosa River R. R., recently purchased. The Tennessee & Coosa River R. R. Co. was chartered to build a railway from Gadsden to Huntsville, Ala., about 85 miles. The line has been completed from Gadsden to Attalla, Ala, about 11 miles, at a cost of nearly $600,000. It is proposed by the N., C. & St. L. Co. to complete the line as originally projected.

Macon & Dublin.—Steps are now being taken toward resuming construction on this old railway projected to run from Macon to Dublin, Ga., a distance of about 40 miles. The greater part of the roadbed was graded seven years ago, so that a small amount of labor will suffice to complete the road. Work, it is now stated, will begin in about a month and the line completed within one year.

South Bound.—The Savannah Construction Co. will receive proposals on and after June 10 for the construction of the first division of the road from Savannah, Ga., north 38 miles. Specifications and profiles can be seen at the office of the Chief Engineer, Geo. D. Wadley, Savannah, Ga.

Projects and Surveys.

Bristol Belt.—Incorporated in Tennessee to build a belt line railway around the city of Bristol, Tenn. B. L. Dulaney is President, and A. B. Whittaker is Secretary.

Kansas City, Chattanooga & Augusta.—This company has made application for a charter empowering it to construct a railway in Tennessee. The incorporators are: Hon. H. Clay Evans, H. S. Chamberlain, D. P. Montague and R. A. Bowie, of Chattanooga; R. C. Cook, of Connecticut; George Little, of Alabama; C. A. Evans, Atlanta, Ga., and J. L. Johnson and Geo. Redmonds, of Charleston, S. C.

Kentucky.—Bills are before the State Legislature to incorporate the Paducah Metropolis & Ohio River R. R. Co.; to incorporate the Accommodation R. R. Co.; to incorporate the Park Land Belt & Riverside R. R. Co.; to incorporate the Rockfield & Northern R. R. Co.; to incorporate the Central Kentucky & Ohio River R. R. Co.; to incorporate the Kentucky & Cumberland R. R. Co.; to incorporate the West Point Belt Line Ry. Co.

Albany, Boston & Florida.—This company has been organized in Georgia to build a line of railway from Albany, via Cordele and Boston, to to the Gulf coast. The officers are: M. R. Mallette, President; J. W. Taylor, Vice-President; D. R. Blood, Treasurer; and W. M. Brooks, Secretary.

Plant City & Fort Mead.—A project is on foot to build a railway from Plant City to Fort Mead, Fla.

Fayetteville & Albemarle.—Steps are being taken toward the early commencement of construction on this road.

NORTHWEST Existing Roads.

Dakota.—A press dispatch contains the following concerning the prospects of railway construction in South Dakota:

During the present year there will be little if any railroad building in South Dakota. The grade may be ironed between Gettysburg and Forest City, in Potter County. This represents only 17 miles. There is talk of a road from Aberdeen to Pierre, and another from Huron to Milbank. These are both future possibilities. Just what the condition is of the Sioux Falls, Yankton & Denver cannot be found out. Boston capitalists have backed out of the deal, but strong efforts are being made to influence other parties to take hold of the project. The Midland Pacific from Sioux Falls to the Pacific Coast is a sure road in the future, but may not be started this year. The poor crops of the last two years have not been favorable to railroad extension, but a good crop or two will bring renewed activity in this direction. Some of our most productive sections are too far from markets. It is only a question of a few years when all this will be remedied. The counties of Charles Mix, Buffalo, Jerauld and several others should have more and better market facilities. What the railroad companies will do with the large reservation area opened to settlement is not known. The Northwestern system stops at Pierre and the Milwaukee at Chamberlain, and so far have not shown any intention of crossing the Missouri River. It is more than probable that neither road will venture into that section in advance of settlement, as was the case east of the river eight or nine years ago.

Chicago, Burlington & Quincy.—The Harney Peak Tin Mining, Milling & Manufacturing Co., of New York City, and the Harney Peak Tin Co., of London have closed a contract with this company to con truct a railway 20 miles long through the joint properties of the company, with side-tracks and switches to the various mines. The road is to be completed to Hill City, So. Dak., by Jan. 1, 1891. V General Manager Holdredge, of the Burlington & Missouri River R. R., is quoted as saying that 30 miles of the proposed line from New Castle, Wyo., to the Big Horn range will be completed by July 1.

Chicago, St. Paul, Minneapolis & Omaha.—Shepard, Sterns & Co., of St. Paul, Minn., have the contract for building the extension of the Goodyear, Neillsville & Northern R. R., from Neillsville to Marshfield, about 27 miles.

Northern Pacific.—Right of way has been secured for the proposed extension of the Duluth, Crookston & Northern R. R., east to a connection with the Duluth & Manitoba R. R., 20 miles.

Chicago & Northwestern.—The engineers of the Fremont, Elkhorn & Missouri Valley R. R. are reported to be surveying a line from Superior, Neb., to Dodge City, Kan., 190 miles. The line, it is stated, will be put under construction this year.

Duluth & Winnipeg.—The constructors are moving their men and plant into position preparatory to commencing construction on this road at an early date.

Chicago, Milwaukee & St. Paul.—The contract for the line from Necedah to Dexterville, Wis., 19 miles, has been let to A. S. Harrison & Co., of Milwaukee, Wis., and work will commence at once. The line will connect at Dexterville, with the Wisconsin, Pittsville & Superior R. R., recently purchased by the C., M. & St. P. Co., and the two lines will form a part of the proposed extension to Superior, Wis. The contract is reported let for the proposed line from Shullsburg, Ill., to Farley, Ia.

Projects and Surveys.

La Crosse, Black River Falls & Eastern.—Hugh H. Price, of Black River Falls, Wis., President, writes as follows:

This road is projected to run from La Crosse, Wis., via Black River Falls, Marshfield and Wausau, to Antigo, Wis., a distance of about 150 miles. About 25 miles of the line has been located and engineers are now running the curves and cross-sectioning. The principal business of the road will be in lumber, iron and general merchandise. The right of way has been secured for the first section of 25 miles and about $12,000 of other local aid obtained. The company will build the line itself and work will begin soon; the first 25 miles will be completed this season. W. D. Henderson is Chief Engineer.

Chicago, Lake Geneva & Pacific.—Elections are being held in the various towns along the route to vote on the question of subscribing bonds in aid of this Wisconsin road.

Quincy & Neota.—A project is on foot to build a railway in Hancock Co., Ill., from Quincy to Neota.

Manitoba & Southeastern.—This company will place engineers in the field at once to locate the line between Winnipeg and the International boundary.

SOUTHWEST.—Existing Roads.

Stuttgart & Arkansas River.—A correspondent writes us that about 25 miles of the line from Dewitt to Pendleton, Ark., have been graded and 10 miles of track laid. The total distance is 45 miles. About 100 men are now at work on the line and it is expected to have it in operation by July 1. The route is through a prairie country for the greater part of the distance. F. M. Gillett, of 5 Wall St., New York City, is President, and T. H. Leslie, of Stuttgart, Ark., is Secretary and Treasurer.

Forth Worth & Rio Grande.—It is stated that this company will begin work at once on the extension from Comanche to Llano, Tex. The surveys have been completed.

Missouri Pacific.—It is rumored that the Cincinnati branch of this road will be extended west to Denver, Colo., this season.

ROCKY MT. AND PACIFIC. Existing Roads.

Great Falls & Canada.—W. D. Barclay, of Great Falls, Mont., Chief Engineer, writes as follows:

This road is projected to run from Great Falls, Mont., along the valleys of the Sun River and Muddy Creek in a generally northwest direction to Leithbridge, Alberta, a distance of 198 miles. The surveys have all been made and the right of way secured. The route is through a prairie country with a considerable heavy work at the crossing of the Teton, Marias and Milk rivers; maximum grade 1%. The road is built in the interest of the Alberta Railway & Coal Co., to furnish an outlet for the mines of Leithbridge. The company has secured a land grant of 6,400 acres per mile for the Canadian section of the line. All the other capital has been secured by the sale of bonds Donald Grant & Co. are the contractors for building the road, and tracklaying is now progressing at the rate of two miles per day. It is expected to have the line open for traffic by Oct. 1. The Illinois Steel Co. has the contract for the rails; the Baldwin Locomotive Works for the locomotives; Wells & French for the cars, and Pettibone, Mulliken & Co. for the bolts and spikes. Donald Grant, of Faribault, Minn., is President.

Pajaro Valley.—P. W. Morey, of Watsonville, Cal., writes us as follows:

This road, which is being built chiefly to accommodate the Western Beet Sugar Co., is projected to run from Watsonville, via Moss Landing, to Salinas, Cal., a distance of 20 miles. Twelve miles of the line from Watsonville to Maro Cajo ranch will be constructed this year. Work is now in progress on this section by the contractors, McMahan & Son, of San Francisco, Cal.; it is to be completed by Aug. 1. The route is through an almost level country. John D. Spreckels is President, and W. C. Waters is Chief Engineer.

Rio Grande Southern.—About 18 miles of the grading from Ridgeway, Col., south have been completed, and it is expected that the road will be completed to Telluride by July.

Denver & Rio Grande.—The survey for the line between Villa Grove and Alamosa, Col., is nearly completed. The survey has been very difficult.

Projects and Surveys.

Calgary & Edmonton.—Alex. Stewart, of Calgary, Alberta, Chief Engineer, writes as follows:

This road is to run from Calgary, northeast to Edmonmonton, 200 miles, and south via Ft. McLeod to the International boundary, a distance 150 miles, making a total length of 350 miles. The surveys were began April 15, and about 200 miles of the preliminary line have been run, and 25 miles located. There will be several large bridges on the route. The main business of the route will be coal, lumber, and agricultural produce.

Alaska.—A press dispatch says:

The project for railway to Alaska is about to take definite shape. Application will be made to Parliament at the next session for the passage of an act incorporating the Vancouver, Northern & Alaska Railway & Navigation Co., with power to build a railway from Vancouver or some other point on Buzzard Inlet on the banks of the Fraser River, by way of Seymour Creek Valley, Pemberton Meadows, Chilcoten Plains, and the headwaters of the Fraser River to a point on the Parsnip or Peace River, with branches in a northeasterly direction to the Skeena and Stikeen rivers, to the boundary of Alaska.

RAPID TRANSIT.

Cable Railways—The Third Av. R. R. Co., of New York City, has again been refused permission to substitute cable for horse power. The General Term of the Supreme Court has sustained Judge Patterson in his opinion that the company's charter does not permit it to use cable power.

The cable railway system of Los Angeles, Cal., has passed under the control of a new corporation composed practically, however, of the same stockholders as that under which it was inaugurated. The company has heretofore been known as the Los Angeles Cable Ry. Co. The name of the new company is the Pacific Ry. Co., of Illinois. Hon. J. F. Crank, who originated the idea of the

sable system in the city, is the President of the new company.

The Hill Top Street Railway Traction Co. has been chartered to build a cable railway to lead to the top of Mt. Washington, Pittsburgh, Pa. The principal incorporators are Dr. W. L. Phillips, president; J. A. McCormick, W. L. Bird, J. C. Mercer, H. Marshall and C. R. Shepler. The capital stock is $150,000, and it is said that a sufficient amount has already been subscribed to assure the building of the road. It will be a cable road, with combination cars that will be fitted with electrical appliances. The line will begin at the corner of Carson and Sycamore Sts., at the south end of the Smithfield St. bridge. The road will extend up Sycamore St., winding around the hill to Shiloh, thence to Virginia Ave., to Wyoming St., to Boggs Ave., returning over the same route. Cables will be used to operate that portion of the road, but it will practically be a feeder to the Birmingham Traction road. The cars will be fitted with electric motors, and after reaching the foot of the hill will be run upon the tracks of the Birmingham line, after that road has been changed to be operated by electricity. A survey of the new road shows that no part of the grade is as steep as that of the Central traction road at the upper part of Wylie Ave. It is considered entirely feasible, and there is every indication that the new road will be built.

Electric Railways.—A bill amending the charter of the Eckington & Soldier's Home Ry. Co. has been introduced into Congress. The amendment grants the company additional right of way in the City of Washington, D. C., and stipulates that the wires shall be placed under ground and that work must commence in three months and the line be completed in one year.

The Rapid Transit Street Ry. Co., of Newark, N. J., has just closed a contract for two Corliss engines to drive its electric plant, and other machinery, to be delivered as soon as built. All the contracts, except for a portion of the cars, are to be completed by the 15th of July. The works will be put in operation as soon as possible after that time.

The Citizen's Passenger Railway of Norristown, Pa., has been sold to a Pittsburgh syndicate, which will substitute electricity for horse power and extend the road.

The Pittsburgh, Munhall & Homestead Street Ry. Co., are asking right of way through the town of Homestead, Pa., for an electric railway.

The Cairo Electric Street Car Line has been chartered to build an electric railway at Cairo, Ill.

The following officers have been elected by the directors of the East St. Louis Electric Street R. R.: G. W. Allen, of St. Louis, President; H. F. Bader, of East St. Louis, Vice-President; P. J. Doer, of St. Louis, Treasurer, and H. D. Sexton, of East St. Louis, Secretary. Work will be commenced at once.

The town of Creston, Ia., is considering an electric street railway.

The Shoshone Falls Power & Electric Ry. Co. has been chartered in Idaho to construct an electric railway from Shoshone to Shoshone Falls.

The Belt Line Electric Ry. Co. has been organized at Port Townsend, Wash., to furnish electric motor power. Incorporators: H. W. Keppes and Jas. McIntyre.

Horse Railways.—The property owners along the route of the Fiftieth St., Astoria & Central Park R. R., which proposes to occupy about eight miles of the uptown streets in New York City, will oppose the granting of a franchise to the company.

The street railway lines of Buffalo, N. Y., have been sold to a syndicate, including M. A. Verner, of Pittsburg; N. Seller McKee and others, of Philadelphia, and Patton & Co., of New York. A new company will be formed, and the transfer will be made in June. Extensions and improvements are proposed.

Rochester Ry. Co. of Rochester, N. Y., has applied for permission to build a number of extensions.

The Consolidated Street Ry. Co., of Syracuse, N. Y., including the Third Ward Electric road, Woodlawn & Butternut, Fourth Ward, Geddes, Fifth Ward, Seventh & Eleventh Ward, Onondaga Valley, Genesee & Water Street Roads, has been organized. These roads embrace about thirty miles of track constructed, with equipment, and ten miles of franchise and projected road.

A belt line street railway is proposed at Camden, N. J., connecting the Pennsylvania and Philadelphia & Reading railways.

The Union County Street Ry. Co., of Elizabeth, N. J. proposes to build several extensions to its lines.

The Tarentum Traction Passenger Ry., of Tarentum, Pa., has been chartered. Chas. E. Bostwick, of Punxsutawney, Pa., is one of the directors.

The Crystal Spring Street Ry. Co., has been chartered at Roanoke, Va. The officers for the first year are: S. W Jamison, President; W. S. McClanahan, Secretary and Treasurer; A. S. Asberry, E. H. Stewart, S. W. Jamison, S. B. Haupt, and J. H. Sands, Directors.

Dummy Railways—The contract has been let for the motor line from Independence to Monmouth, Ore. It is to be completed by June 1.

A motor road from Tacoma to Sumner, Wash., is being talked of.

The Chicago Arcade Rapid-Transit Ry. Co. has been formed in Chicago to construct a road from a point in Fifth avenue, between Madison and Harrison streets, with branches in Milwaukee and North avenues, to the present or future city limit, the capital stock to be $8,000,000. The incorporators and first Board of Directors are E. Louis Kuhns, H. A. Ritter, A. F. Shuman, Percy L. Shuman and Joseph H. Defrees, all of Chicago.

The Austin Travis County Rapid-Transit Co. has been organized at Austin, Tex., by the election of the following officers: M. M. Shipe, President; J. H. Urie, Secretary, and C. H. Liebold, Treasurer, all of Kansas City.

HIGHWAYS.

New York.—The Albany, N. Y., *Journal* says: "The Ulster Co. branch of the Farmers' League has taken up a question of the highest practical interest in its endeavor to bring about a radical change in the present iniquitous and inefficient highway system. The defects of the present system have long been apparent, and various suggestions have been made looking in the direction of improvement. The subject was considered by Governor Hill in his latest annual message, and the hope has been indulged that some relief might be furnished by the action of Legislature. The plan of the Ulster farmers is to put the work on highways in charge of town supervisors, with a county superintendent to oversee it generally. They propose the holding of a State conference under the direction of the State Farmers' League, and thus to organize public opinion in time for the necessary action to be taken by the Legislature next year. This is a wise movement, and if it is energetically prosecuted it will result in great good."

New Jersey.—The Board of Freeholders of Elizabeth, N. J., have received the following bids on the county roads:

B. M. & J. F. Shandley, 16 Exchange place, Jersey City, N. J., on road through the township of Cranford for earth excavation per cu. yd., 40c.; for macadam or telford pavement per sq. yd., $1.40. On road through township of Union: For excavation per cu. yd., 40c; for macadam or telford pavement per sq. yd., $1.40. On road through the city of Elizabeth: For excavation per cu. yd., 40c.; for macadam or telford pavement per sq. yd., $1.23. —Lighthipe & O'Reilly, Orange, N. J. On road through township of Cranford: For excavation per cu. yd., 30c.; for macadam or telford pavement per cu. yd., $1.25. On road through township of Union: For excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., $1 25. On road through township of Springfield: For excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., 95c.—John A. Hicks, Summit, N. J. On road through township of Springfield: For excavation per cu. ft., 35c.; for macadam or telford pavement per sq. yd., $1.10.—A. F. Hoffman and John Z. Hatfield. On road through township of Cranford: For excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., $104.—John M. Weldon, Jr., Rahway, N. J. On road in the city of Elizabeth: For excavation per cu. yd., 2'c.; for macadam or telford pavement per sq. yd., $1.15. On road through the township of Cranford: For excavation per cu. yd., 31c.; for macadam or telford pavement per sq. yd., $1.17.—Edward N. Lynch, 279 Morris Ave., Elizabeth, N. J. On road through the township of Cranford: For excavation per cu. yd., 80c.; for macadam or telford pavement per sq. yd., 87c. On road through township of Union: For excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., 90c. On the road in the city of Elizabeth: For excavation per cu. yd., 45c.; for macadam or telford pavement per sq. yd., 98c. On the road through the township of Springfield: For excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., $1.08.—Thos. A. Nevius, Orange, N. J. On the road through the township of Cranford: Earth excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., 95c. On the road through the township of Union: Earth excavation per cub. yd., 30c.; for macadam or telford pavement per sq. yd., 95c. On road through the township of Springfield: Earth excavation per cu. yd., 30c.; for macadam or telford pavement per sq. yd., 90c.

Maryland.—As a result of the change made by the Legislature of 1890 in the Baltimore county road laws, the county commissioners have passed an order directing that a notice be published in the newspapers inviting proposals to repair the county roads in sections of one, two or three miles. The proposals are to contain a statement that the roads will be kept in order from June 8 to Dec. 31, 1890, and the contractor must give bond in double the amount of the contract price for the faithful performance of the work. Specifications are to be furnished to intending applicants by the board of road supervisors of each district. Each application is to state at what price the applicant proposes to do the work. Bids are also to be made for furnishing stone and other hard materials at such places on the several roads or sections of roads as may be designated by the boards of road supervisors at the times required by the specifications. All proposals are to be addressed to the boards of road supervisors, and to be subject to approval of and ratification by the county commissioners. Bids are to be mailed to the chairman of the board of road supervisors in whose district the work is to be done, and the bids are to be opened on the third day of June.

Alabama.—The Montgomery *Advertiser* says the question of good roads will be a leading one in the next Legislature of Alabama. "Roads that are well worked and kept in first-class condition attract population, increase the value of real estate and property generally, reduce the cost of transportation, and thus encourage the greater exchange of products between sections, and promote intercourse and development wherever they may exist."

Washington.—Jefferson Co. intends to spend $40,000 on public roads the present year.

Oregon.—The citizens of Toledo have subscribed $2,000 to be used in the construction of a wagon road from Toledo to Yaquina City, a distance of about 4 miles. It is understood that a similar amount has been subscribed at Yaquina City for the same purpose. A part of the driveway will be planked, and a fine road will be the result between the two towns.

WATER-WORKS.

NEW ENGLAND.

Greenville, Me,—A water supply has been introduced. Water is taken from a spring located on Simpson's Hill.

West Newton, Mass.—Albert S. Glover, ex-Water Registrar, has kindly sent us the following table, showing the bids received for constructing a covered masonry reservoir of 2,000,000 gals. capacity:

	Quantities.	Thos. A. Rowe, Newton.	O'Mahoney & Trumbull, Lawrence.	Wm. H. Ward, Lowell.	Howard, Coon & Co., Cambridge.	Smith, Mahoney & Dorman, Lawrence.	W. H. Magee, Newton.	Geo. M. Atkins & Co., Palmer.	John H. Leavitt, Boston.	D. Henry Cram, Boston.
Removing loam to spoil bank	1,500 cu. yds.	$ .23	$ .22	$ .30	$ .25	$ .50	$ .25	$ .50	$ .25	$ .24
Removing loam from spoil bank placed	2,500 " "	.34½	.32	.50	.40	.75	.30	.50	.29	.30
Sodding	3,000 sq. "	.46	.35	.60	.45	.75	.72	.40	.38	.75
Excavation	4,500 cu. "	.52	.43	.70	.60	.75	.53	.55	.43	.57
Additional haul, per 100 ft.	100 " "	.01	.01	.05	.05	.15	.02	.01	.01	.01
Rock excavation	50 " "	1.15	.70	1.00	2.75	2.50	2.00	1.00	1.50	2.50
Puddle	125 " "	3.16	2.00	3.00	4.50	3.25	3.50	1.00	3.00	4.75
Broken stone	150 " "	2.83	2.50	4.00	3.50	5.00	3.50	3.00	3.95	4.00
Permanent timber	10,000 ft.	46.00	38.50	30.00	45.00	37.50	35.00	30.00	30.00	33.00
Portland cement	10 bbls	3.15	2.65	3.30	3.50	3.25	2.75	3.50	3.00	3.10
Concrete masonry	850 cu. yds.	6.90	6.25	8.50	6.75	7.50	4.85	6.00	6.25	5.75
Brick masonry	530 " "	17.25	18.00	15.00	16.00	32.50	14.25	12.00	15.50	14.75
Rubble stone masonry	3,000 " "	5.17	5.25	8.00	6 40	8.50	5.63	5.85	5.35	5.50
Portland cement plastering	900 sq. "	.58	.33	1.00	1.25	.50	.27	.40	.50	.40
Coal tar coating	2,200 " "	.23	.10	.50	.23	.25	.22	.03	.10	.23
Granite coping	40 lin. ft.	3.45	2.85	2.00	2.15	6.25	2.23	3.00	3.00	2.95
Granite edge stone	580 " "	1.75	2.60	2.35	2.45	4.00	2.75	2.00	.75	1.98
Granite steps	30 steps	17.25	12.85	12.00	12.00	18.75	12.85	13.00	8.00	14.90
Granite trimmings to doorway	6 cu. yds.	28.75	44.00	30.00	37.00	50.00	38.33	50.00	20.00	56.66
Granite blocks	5 " "	17.25	15.00	20.00	37.00	35.00	38.50	25.00	20.00	54.00
Add'l price for Amer. cem. mortar 1 to 1	20 " "	.86	.78	1.00	1.60	1.87	.35	.75	1.00	.15
Add'l price for Portland cem. mortar 1 to 1	250 " "	2.00	1.60	3.00	5.80	4.00	.75	2.50	1.00	.75
Add'l price for Portland cem. mortar 1 to 2	250 " "	1.15	1 06	1.50	3.00	2.50	.60	2.00	1.00	.50
Add'l price for Portland cem. mortar 1 to 3	50 " "	.87	.78	1.00	2.00	2.25	.40	1.50	.80	.40
Drainage tiles	2,100 lin. ft.	.09	.07	.25	.10	.20	.06	.15	.04	.15
Laying 24-in. water pipe	100 " "	.58	.88	.40	.50	.44	.60	.40	.40	1.05
Laying 20-in. water pipe	200 " "	.57	.62	.20	.40	.40	.50	.30	.37	.92
Laying 12-in. water pipe	40 " "	.37	.40	.25	.30	.25	.25	.20	.30	.65
Setting iron work in gate chamber		.....	.....	.....	.....	.....	.....	.....	.....	.....
Amount of bids		41,586	39,948	53,201	47,396	66,490	39,907	40,005	37,681	41,436

The contract was awarded by the Newton Water Board on May 20 to John H. Leavitt, of Boston. The George F. Blake Mfg. Co., of Boston, has been awarded the contract for furnishing one 5,000,000-gall. pumping engine and two Belpaire locomotive-type boilers, at $33,221.

The Weirs, N. H.—The Winnipiseogee Camp-Meeting Association recently met in Concord and opened bids for putting in the proposed new system of works at The Weirs for supplying their grounds, those of the Veterans' Association and the village of Laconia. The contract was awarded to Bartlett, Gay & Young, of Manchester. The contract was not signed, as it was discovered that under its title to its grounds, the association had no right to divert the water of their springs on it, or supply it to any outside parties. The matter was to have been definitely settled on May 28.

Concord, N. H.—Perry M. Blake, Consulting Engineer, of Hyde Park, Mass., has filed an exhaustive report upon the question of improving the water supply system, in which he states that it will be necessary to establish a reservoir higher than the Penacook Lake, to which water will be pumped. He estimates the cost of the proposed improvements at $100,000.

Manchester, N. H.—A new high service reservoir is to be constructed. The estimated cost is $50,000. It is proposed to construct a new pumping station near East Manchester. Surveys and plans are being made by Engineer J. B. Sawyer.

MIDDLE.

Medina, N. Y.—We have received the following:

Bassett Bros., of Buffalo, will commence the construction of the new works about June 1. Water will be pumped from a well to a stand-pipe. The estimated cost is $100,000. The plant is to be in operation about Nov. 1.

Buffalo, N. Y.—The Governor has signed the bill authorizing the city to issue 3½ per cent. bonds for the construction of a reservoir.

Hamburg, N. Y.—The Hamburg Water and Electric Light Co. has filed a certificate with the Secretary of State indicating an increase of its capital stock from $12,500 to $50,000. The original capital is reported as all paid in, and the debt of the company will not exceed $23,000.

Ellicottville, N. Y.—The Ellicottville Water Co., with a capital of $10,000, has filed articles of incorporation with the Secretary of State. C. P. Vedder, President; E. S. Stewart, Vice-President; E. S. King, Secretary; C. A. Case, Treasurer. Work will be commenced as soon as possible.

Cattaraugus, N. Y.—The Cattaraugus Water Co. has been incorporated with a capital of $25,000, for the purpose of supplying the residents of Cattaraugus Co. with water. Stamford is named as the office and headquarters of the company. The incorporators are: George N. Cowan, William H. Cowan, J. B. Cowan and W. H. McAlpine, of Stamford; W. R. Brock, of Hobart; and E. H. Cohen and J. Brown, of New York.

Penn Yan, N. Y.—A vote will probably be taken on July 1 to determine whether the board shall enter into a contract with a company for supplying water for fire and sanitary purposes. The proposed plan is to contract for 60 hydrants at $2,750 per year.

Peekskill, N. Y.—Bills 412 and 413 have been signed by the Governor. The first authorizes the Water Commissioners to issue bonds for extending water mains, and the second authorizes the commissioners to issue bonds for connecting water mains and increasing the protection from fire.

Rochester, N. Y.—An ordinance has been passed by the City Council authorizing an expenditure of $27,000 for extending mains in the city. The following resolution has also been passed:

That a committee be appointed to inspect Hemlock Lake, its tributary, reservoirs, etc., to act in conjunction with the Executive Board in the prevention of the causes of deterioration of the water; and to report any violation of the existing rules for the preservation of the sanitary condition of the water supply; also to make at least three inspections every year, at such times as may hereafter be designated.

Syracuse, N. Y.—Sealed proposals will be received by the Water Commissioners for the purchase of city water bonds to the amount of $500,000, dated July 1, 1890, payable 30 years after date, interest at 3 per cent. per annum, payable semi annually, until June 9. These bonds are issued for the purpose of raising money for the acquisition, and construction of a system of works, and for the purpose of acquiring property, rights, privileges and franchises therefor, or to be used in connection therewith, and for providing a compensating water supply for the Erie Canal, authorized by Chapter 291 of the laws of the State of New York, as amended by the laws of 1890.

Canandaigua, N. Y.—The Village Trustees have authorized the water company to extend its mains through Coach St., and to erect an additional hydrant on Coach St. near the intersection of Bemis St.

Middletown, N. Y.—The contract for constructing the new reservoir has been awarded to Jehiel Vaughn, at $67,571. Hocstader & Curran, of Poughkeepsie, bid $104,778.18.

Madison, N. J.—A vote will be taken on June 10 to decide the question of spending $75,000 for water, etc.

Conshohocken, Pa.—J. Lukens, president of the water company, informs us that the kind of valves to be used are "under consideration."

Lehighton, Pa.—Engineer C. N. Butler has sent us the following information:

The Lehighton Water Co. is extending the plant built last fall. A dam is being built on Long Run. The reservoir will have a capacity of 1,500,000 galls. The supply will reach the distribution system by gravity through 3 miles of 8-in. pipe. Coon & Co. are the contractors.

SOUTHERN.

Warrenton, Va.—The Glamorgan Co., of Lynchburg, has been awarded the contract for the new works. Three springs will be connected from which to draw the supply, which will be conveyed by gravity to a reservoir of 1,500,000 galls. capacity. Contract price, $30,000.

Henderson, N. C.—A system of works is to be constructed. A water company has been organized, and work will be prosecuted without delay.

Spartanburg, S. C.—The water company is extending the main pipe to Converse College.

Aiken, S. C.—At a recent meeting of the Water-Works and Light Co., a committee comprising D. S. Henderson, H. Hahn and Wm. Turnbull was appointed to confer with the authorities of the town and arrange a contract.

Anderson, S. C.—Work is progressing rapidly.

Greenville, S. C.—At a recent special meeting of City Council it was decided to establish a system of city works and to advertise for bids for building such a system, the bids to be received until June 3.

Madison, Ga.—The Mayor and City Council are negotiating with companies to erect water and electric light works.

Tallapoosa, Ga.—The Tallapoosa Water Co. has been incorporated by E. F. Fuller, J. F. Fuller, J. M. Crane, of New York City, and others. Capital stock, $75,000.

Brunswick, Ga.—The Brunswick Light & Water Co. is erecting a 2,000,000-gall. Worthington pump.

Tennille, Ga.—Correspondence with contractors is solicited. Address J. C. Harman.

Savannah, Ga.—David Douglas, President of the Mutual Gas Light Co., has submitted a report to the citizens, claiming that one-half of the present supply is wasted, and that, instead of putting in a new system, steps should be taken to stop the present waste. The *News*, in recommending the steps which the Councilmen should take, states:

First, they should satisfy themselves beyond all doubt that the water is being wasted. Second, having settled that point they should do one of two things, put in water meters and make people pay for all the water they use, or have every house thoroughly inspected by a plumber in whom they have confidence and compel those whose houses have defective water appliances to provide first-class ones under pain of being deprived of water.

Atlanta, Ga.—The City Council has ordered that the $250,000 of improvement bonds shall be issued.

Bridgeport, Ala.—Another report states:

The Chattanooga (Tenn.) Foundry and Pipe Works will construct works.

Macon, Miss.—The following is from W. G. Selleck:

The Corporation of Macon will construct works costing $10,000. Water will be pumped from the Nosubee River through a main 5,482 ft. long to a tank or stand-pipe; thence by gravity to the distribution system.

NORTH CENTRAL.

Harrison, O.—A vote has recently been taken on the question of issuing bonds for constructing works. Address Mayor Graft.

Cincinnati, O.—The report of the Board of Experts has been submitted. It is composed principally of specifications for the improvement of the pumping machinery, the cost of which is estimated at $80,000. They also recommend the purchase of new boilers of 1,560 H. P. capacity.

Huntington, Ind.—The Huntington Water-Works Co. has been incorporated with a capital stock of $100,000. The directors are: Wm. McGrew, Geo. Bippus and Julian Dick.

NORTHWESTERN.

Minneapolis, Minn.—City Engineer Rinker is considering plans for improving the city water service. The high-pressure service for the benefit of the Kenwood and Forest Heights districts entails a large expense on the city and accommodates only a very few consumers. It is intended to erect a separate pumping station for this district to connect with the present mains, or to add a high-pressure pump to the north side equipment.

Owatonna, Minn.—Construction will be commenced about June 1.

Stillwater, Minn.—A petition has been received by the City Council asking for the extension of the water mains on Olive, between Holcombe and Greely Sts.

Duluth, Minn.—The City Council has passed an ordinance prohibiting the laying of pipes for any purpose under the waters of Duluth Harbor, unless the consent of the council has first been obtained. This is done to prevent the carrying out of the plans of the West Superior Gas & Water Co., to cut across Minnesota point, and lay their intake water pipes into the lake that way.

Springfield, So. Dak.—A vote will soon be taken on the question of building a system of works.

Helena, Mont.—The residents of the Hauser addition, west of Madison Ave., have presented a petition to the City Council, asking for the extension of the water system to their premises.

SOUTHWESTERN.

Lamar, Mo.—The citizens have ratified the water-works contract by a majority vote of 500.

Yoakum, Tex.—At the next meeting of the Board of Aldermen the question of building works will be decided. A city charter has recently been adopted.

Boulder, Col.—The City Council is advertising for new bids for the construction of works. It is estimated that the entire system will cost less than $100,000. The present system, owned by the town, is worth $100,000.

PACIFIC.

Olympia, Wash.—The new water company has secured land upon which to build a new reservoir. It will be elevated 210 ft., and will have a capacity of 200,000 galls.

Medford, Ore.—Adkins & Webb have completed the new works.

Monrovia, Cal.—The citizens have voted $40,000 of bonds for a new water system.

San Bernardino, Cal.—F. C. Finkle, Chief Engineer of the water-works, informs us that the following bids have been received for constructing the new reservoir:

Bidders.	Price per cu. yd. for excavating.	Total.
John Carroll, San Bernardino	17½ cts.	.....
Gray Bros. Artificial Stone Co., San Francisco	14	$9,772.00
Driver, Phillbrook & Carr, San Bernardino	..	12,348.50
E. N. Townsend, Los Angeles	14	12,500.00
E. Vieweger, San Bernardino	21½	8,684.00
H. R. O'Brien, San Bernardino		9,700.00
Ansel Ames, Los Angeles	15	10,652.77
E. Daley, Jr., & C. J. Daley, San Bernardino	16 45-100	.....
Drew & Ball, San Bernardino	21¼	.....
M. McDonald, San Diego	25	13,100.00

The contract was awarded to E. Vieweger.

PROJECTS.

Herman, N. Y.—Hoosick Falls, N. Y.: B. C. Armstrong, Town Clerk. Pell City, Ala. Spring City, Tenn.: Anglo-American Association, L't'd.—Cattlesburg, Ky.: W. A. Patton, President Cattlesburg Water Co.—Marysville, O.: Hiawatha, Kan.—Alliance, Neb.—Hot Springs, So. Dak: Denton, Tex.: W. H. Camp.—Goldendale, Wash.

ARTESIAN WELLS.

Warsaw, N. Y.—The contract for putting down the second public well has been let to Craveth & Charles. The price for all work and material is $1.60 per ft.

Madison, Fla.—The town has raised $2,000 for boring a well.

Parker, So. Dak.—Sealed proposals for sinking an artesian well, well to be cased with best 6-in. iron casing, will be received until June 9. All bids must be accompanied by a certified check or draft in the sum of $200. The contract will be awarded to the lowest bidder. B. W. Kumler is the Village Clerk.

Wolsey, So. Dak.—The town has voted to issue bonds for $2,500 for sinking a well.

Corsicana, Tex.—A well will probably be sunk.

Waco, Tex.—It is reported that a stock company with a capital of $250,000 will be organized to sink wells in Mc Lennan and other counties.

Battle Mountain, Nev.—A well is to be sunk to a depth of 1,000 ft.

IRRIGATION.

Culbertson, Neb.—The county commissioners of Hitchcock Co. will be asked to call an election to vote $18,000 of bonds on the Culbertson precinct for the construction of a canal.

Denver, Col.—The capital stock of the Allen Ditch Co., of Arapahoe Co., has been increased to $10,000.

Colorado Springs, Col.—The Ute Pass Land and Water Co. has been incorporated. The capital stock is $800,000. The company will operate in El Paso Co.

Santa Fe, N. M.—Articles of incorporation for the Guadalupe Valley Reservoir, Irrigating and Mfg. Co., have been filed with the Territorial Secretary. The incorporators are: Wm. A. Miley, W. W. Paul, J. B. Matthews, I. C. Tillason, W. L. Rynerson, J. H. Roley, F. Lesnet, I. B. Powell, J. F. Hinkle, G. M. Casey, J. I. Thornton, J. J. Dolan, S. S. Terrill, and W. S. Ryan. Their object is to construct and operate water reservoirs, ditches, and pipe lines for purposes of agriculture and manufacture. The waters are to be taken out of Lower Penasco River, in Lincoln Co. The main canal is to be 20 miles long, leading to Eddy Co. The capital stock is $500,000.

Ellensburgh, Wash.—The irrigation ditch to supply water to Ellensburgh and vicinity will be 60 miles long. Water will be taken from Katcheeze Lake, near Easton.

Anacortes, Wash.—Work is in progress on the ditch near this city. The estimated cost of the plant is $40,000.

Independence, Ore.—A survey has been made for a water ditch from the Williamette River, 5 miles distant, and a fall was found sufficient to pay for building. The cost is estimated at $30,000.

Fresno, Cal.—The Board of Directors of the Sunset Irrigation District has ordered the issuance of bonds to the amount of $180,000 for the construction of a canal. The

canal will be 100 ft. wide by 16 ft. deep, and about 20 miles long.

SEWERAGE AND MUNICIPAL.

Sewerage.—Brooklyn, N. Y.; Notice is given that the assessment for the estimated cost of building sewers in Map J, District 22, Subdivision No. 15, has been completed by the Commissioners of City Works. Objections to said assessments will be heard on June 7.

Denver, Colo., has established the Lawrence St. public storm sewer and provides for its construction at a cost not exceeding $9,722. It will be brick or cement pipe sewer 40 and 33 in. diameter, and pipe sewers of 12 in. diameter. The lengths are 200 lin. ft. 12-in. pipe, 480 ft. brick or cement sewer 33 in. diameter and 995 ft. of 40-in. brick sewer; 3 catch-basins, 2 special basins and 6 manholes.

Denver will also build the Stout St. and the Glenarm St. storm sewers; the first to cost $32,475 and the second $39,710. For Stout St. the quantities will be, 720 ft. 54-in. brick or cement sewer; 480 ft. 50-in. brick or cement; 300 ft. 38-in. brick or cement; 480 ft. 36-in. sewer; 240 ft. 33-in. sewer; 240 ft. 12-in. pipe sewer. The Glenarm sewers range from 50 ins. to 12 ins. in diameter.

Kansas City, Mo., is just about building 1,558 ft. of 6-ft. brick sewer, 644 ft. of 8-ft. 3-in. sewer, and 315 ft. of 8-ft. 9-in. sewer. These are on the O. K. Creek line. On the second section of this same sewer, also to be built at once, there will be 787 ft. of 10-ft. 6-in.; 843 ft. of 11-ft.; 787 ft. of 11-ft. 3-in., and 571 ft. of 11-ft. 7-in. sewer. The probable cost is about $100,000. Some legal complications may postpone the letting.

Montgomery, Ala., has invested $125,000 in a sewerage system, and now complains that the citizens do not take advantage of the draining facilities offered.

Newport, Ky., Councils have been petitioned to instruct the City Engineer to report the estimated cost of levecing the low land against a river rise of 64 ft., and of properly sewering the city. For this purpose the engineer would be permitted four assistants at an aggregate cost not exceeding $250 per month.

Rochester, N. Y., is discussing sewage disposal, and Mr. G. W. Rafter, at a meeting of the East Side Taxpayer's Association, last week, favored the filtration method of disposal as the best for local conditions.

Municipal.—Buffalo, N. Y., is authorized to issue $75,000 in bonds to erect a new municipal building.

Girard, Kan., has turned over part of its new City Hall to Crawford Co. as a court house, the county assuming an incumbrance of $8,975.

Streetwork.—Omaha, Neb., has awarded contract for street cleaning for 5 years to C. E. Squires at $15 per mile. The bids ranged from $11.50 to $24.50 per mile. Omaha paid the Barber Asphalt Co., in 1889, $6,673.05 for repairs to asphalt pavements. This is under a contract which provides that the city shall pay 8 cts. per sq. yd. of Trinidad asphaltum pavements in the city; the contract running 10 years from March 12, 1889. Each asphalt paved street in the city comes under this contract as soon as the 5 year guarantee has expired, and for this 8 cts. the Barber Company binds itself to keep the pavements in good repair at all times. These repairs, however, do not include breaks in the pavement for gas or water connections, which are paid for by the person making the opening, at the original pavement price.

St. Louis, Mo., in answer to U. S. Census inquiries, presents the following list of streets, etc., in that city: Miles of streets in the city limits, 817.92; miles of alleys in the city limits, 242.71; miles of granite paved streets, 41.35; miles of macadam paved streets, 291; miles of asphalt paved streets, 3.95; miles of wood paved streets, 5.45; miles of improved streets, 476.17; miles of improved alleys, 162.44; average width of streets, 60 ft.; widest street, 150 ft.; narrowest street, 32 ft.; average yearly cost of improving streets during the past 10 years, $577,853; average yearly cost of street repairs during the past 10 years, $257,451; average yearly cost of street cleaning during the past 10 years, $126,804.

Denver, Col., is preparing plans, estimates and specifications for paving Fifteenth and Sixteenth Sts. with asphalt. The work is to be let shortly.

Chicago, Ill., opened bids last week for paving 250,000 sq yds. of streets, at prices ranging from 95 cts. to $1.25 per sq. yd.

Gloucester, Mass., has reconsidered its resolution of the board of aldermen to borrow $20,000 for paving Eas' Main street, and made the sum $10,000.

Belleville, Ill., is to spend $19,000 on street grading and paving.

Louisville, Ky., has authorized a large amount of grading, curbing and macadam pavement for the streets of that city.

White Plains, N. Y., is authorized to raise $12,000 for highway purposes.

Walla-Walla, Wash., will vote in July on the question of putting in a sewerage system. The City Council have authorized the construction, subject to this vote.

Westfield, Mass., has let contracts for laying from 12,000 to 15,000 ft. of pipe sewer to Sackett Bros., of that city, for 13,000. The contract for furnishing the pipe sewer was et to J. S. Clark.

Orange, Mass., voted to build a system of sewers in March last, and has now awarded the contract to Lucian A. Taylor of Boston, for $62,954.

North Yakima, Wash., on May 17, voted to bond the city for $40,000 for building a sewerage system.

Columbus, O., has issued $10,000 in bonds to build the Wall St. trunk sewer.

Chicopee, Mass., will receive proposals until June 2 for building a new sewer at the falls. The work must be commenced on June 10 and completed in two months.

Milwaukee, Wis., awarded brick sewers, on May 20, at the following rates: $11.70 for 84-in. diam., $4 for 36-in., $3.30 for 30-in. and $2 for 18 in.; for furnishing gravel for street repairs, $1.09½ per cu. yd.

Albany, N. Y., has voted in favor of bonding the city for $75,000 to be expended in completing the city's sewers, to build a city hall, and to aid in the construction of a bridge across the Williamette.

Hagerstown, Md., has been authorized by the Legislature to issue $22,000 in bonds for a drainage system, and also $8,000 in bonds for street purposes. This act has been ratified by a vote of the citizens.

Holyoke, Mass., is to build the Main street sewer, 2,280 ft. long, at a cost of $15,584. It will be 20-in. vitrified pipe, and 24 and 30 ins. brick sewer, ending in a 4-ft. sewer.

Union, N. J., will open bids on June 7 for building about 8,400 ft. of main sewers, from 3 to 8 ft. diameter. Address Chas. B. Brush, No. 1 Newark street, Hoboken, N. J.

Ogden, Utah, opens bids on June 30 for 20,000 ft. of vitrified pipe. Address T. A. Perkins, City Engineer.

Dayton, O., has sold $300,000 sewer and street bonds to N. W. Harris & Co., of Chicago, at $12,750 premium.

Wheeling, W. Va., has authorized a considerable amount of sewer work for the current year.

Hastings, Neb., will sell $40,000 sewerage bonds, in $500 lots, 5%, 20 years time. Address A. L. Clarke, Mayor of Hastings, Neb.

Marion, O., has sold to C. G. Harraman, of New York, $25,000 sewer bonds at 6% premium.

Saginaw, Mich., in its city tax-roll of May 19, estimates $224,973 for school, highway, water, sewer and street improvements, for the coming year.

Buildings.—Nevada, Mo., is to have a $20,000 passenger depot on the Missouri, Kansas & Texas R. R. at that point.

Little Falls, Minn., is to build a new city hall this season.

East St. Louis, Ill.—The Odd Fellows of this city are to build a new hall, 70 × 120 ft., three stories high, to cost $40,000.

Saginaw, Mich.—The Masonic fraternity will build here a Masonic home to cost about $50,000. The building will be 60 × 120 ft. and five stories high.

A new court-house for Baltimore, Md., is to be built, with Mr. George Archer as architect.

ELECTRICAL.

Electric Lighting.—The Calkin Electric Light Co., which has the contract for lighting the city of St. John, N. B., will extend its arc system and also introduce the incandescent system. The Fort Wayne Electric Light Construction Co., of Fort Wayne, Ind., has the contract for putting in the lights. It is also intended to enlarge the dynamo station and put in four new 150 H. P. engines.

The Rockland Electric Construction Co., of Rockland, Me., has been organized with the following officers: President, A. M. Copp; Treasurer and Agent, C. C. Moses; Clerk, Charles T. Frost, of Rockland.

The buildings for the new electric light plant at North Adams, Mass., have been completed and work will begin at once on the pole line construction. The work is being done by the Wright Electrical Engineering Co., and is to be completed by July 1.

The United Electric Light Co., of Springfield, Mass., has commenced construction on the proposed addition to its system. The improvements include the construction of an extension to the dynamo house 75 ft. long and 54 ft. wide, the purchase of one 300 H. P., two 315 H. P. and one 300 H. P. Hazleton engines; two Westinghouse incandescent machines of 1,500-light capacity each, and two new motor generators, one of which will furnish power for the South End street railway and the other provide for the company's commercial motor business. The two-story office building has been completed.

The Woonsocket Electric Machine & Power Co., of Woonsocket, R. I., will increase the power of its works by putting in a 275 H. P. water-wheel of the Rodney Hunt pattern.

Work on pole lines for the new electric light system at Arctic Center, Conn., will commence shortly.

The Merchants' Electric Light Co. is seeking the right to establish an electric light plant at Rockville, Conn.

The village of Fredonia, N. Y., will hold an election to consider the voting of a tax to establish an electric light plant, to cost $10,000.

By a vote of 245 for and 19 against the taxpayers of Ilion, N. Y., have decided that the trustees be empowered to raise by assessment and tax the sum of $2,720 annually for the purpose of lighting the village by electricity. It is expected that the plant will be ready for operation in about one month.

The Highway Commissioners of the town of Jamaica L. I., have granted to H. C. Buckhout & Co., of Brooklyn, N. Y., the privilege to erect poles and to lay tubes in the highways of the town of Jamaica for the operation and maintenance of electricity for light and power. This township embraces Queens, Hollis, Springfield, Richmond Hill, Jamaica, Woodhaven, Morris Park and Ozone Park. The conditions of granting the franchise are that operations shall begin within one year, and that an indemnity bond shall be filed with the County Clerk, subject to the approval of the Board of Supervisors, to indemnify against loss or damage by negligence or carelessness on the part of the company or its operatives and employés. The grant is for fifty years. Buckhout & Co. propose to commence operations in the summer. It is intended to furnish both the arc and incandescent systems.

A special session of the Medina, N. Y., Common Council was held recently, at which the electric light matter was finally disposed of. The contract was awarded to the Syracuse Electric Construction Co., and calls for 41 street arc lights of 2,000 c. p., to burn 23 nights each month, until 1 o'clock A. M. Also the free lighting of the Village Hall and police headquarters. The contract was made for a term of 5 years; extra lights will cost the village $60 each. Mayor Hill expects the lights to be in operation by the middle of September.

Electric lights are talked of at Salem, N. Y.

The Lonaconing Electric Light & Power Co., of Lonaconing, Md., has been chartered by J. J. Robinson, Wm. Atkinson and others. The purpose of the company is to erect an electric light plant.

The Uniontown Electric Light and Power Co., of Uniontown, Pa., has been awarded the contract for electric lighting in that town for a period of 3 years, at a cost of $2,800 per annum.

The Millersburg Electric Light Co. has been organized at Millersburg, O.

The Globe Contract Co. has closed a contract with the Grafton Electric Light, Heat & Power Co., of Grafton, W. Va., for an electric plant consisting of 25 arc and 500 incandescent lights, installed complete, for the sum of $11,000. It is to be completed by July 10, 1890.

The Rock Hill Electric Light Co., of Rock Hill, S. C., has been incorporated by W. B. Wilson, Jr., and others to erect electric light works. The capital stock is $10,000.

The city of Gainesville, Ga., will hold an election to consider the issuing of $40,000 of bonds for the construction of water-works and to purchase the Gainesville, Ga., electric light plant.

The Maysville Electric Light & Power Co. has petitioned the city of Maysville, Ky., for power to erect an electric light plant.

Worrall Electric Construction Co. has been organized at Chicago to construct and maintain electric plants. Capital stock, $500,000; incorporators, C. E. Gaylord, M. J. Frost and C. Y. White.

The Commissioner of Public Works of Chicago, Ill., has issued permits to the Chicago Telephone Co. to remove its lines from poles and place them in a conduit between Polk and Twenty-second Sts. on Clark St., and to the Western Union Co. to run a conduit for the same purpose on Canal St. from Kinzie to Sixteenth.

The city of Lebanon, Mo., has voted to light the city by electricity.

The Brinkley Water-Works, Electric Light & Power Co., of Brinkley, Ark., has been incorporated to put in an electric light plant. President, W. S. McCullough. The capital stock is $75,000.

The construction of an electric light plant is contemplated at Cuero, Tex.

The Sacramento Electric Construction Company of Sacramento, Cal., has been incorporated by W. Gambs, W. B. Lazard, G. W. Daywalt, W. R. Lett and W. B. Reynolds. The capital stock is $1,000,000, of which $250 has been subscribed.

The Rhodes & Keese Electric Co. of Los Angeles, Cal., has been incorporated by Col. G. Wiley Wells, J. B. Colby, S. J. Keese, T. H. Rhodes, W. I. Keese. The capital stock is $25,000, of which $15,000 is subscribed.

Stockton Electric Company of Stockton, Cal., has been chartered for the purpose of operating in the city of Stockton; capital stock, $1,000,000, divided into 100,000 shares. Directors: F. E. Birge, Thomas E. Curran, A. Humphrey, G. A. Koch, J. J. Scoville.

San Jose Construction Company, of San Jose, Cal., has been chartered to conduct a general electrical business in San Jose; capital stock $1,000,000, divided into 100,000 shares. Directors: M. B. Hickok, George H. Lee, F. B. Pritchard, G. W. Chamberlain, J. J. Scoville.

The town of Telluride, Col., has contracted for an electric lighting system.

Water Power for Electric Light Plants.—Several towns in Idaho which have water power are utilizing it in operating electric light plants. The Boise plant consists of 1,000 lights; Moscow, 750; Hailey, 500, and Blackfoot, 500-light plant. Caldwell has ordered one of 500 lights, and Wallace has under contemplation a 650-light plant.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Tonawanda, N. Y.*—The bill re-appropriating $20,000, and making a further appropriation of $12,000 for an iron bridge over the Tonawanda creek and Erie Canal at Tonawanda, has been signed by the Governor.

Towson, Md.—W. H. Shipley has prepared and submitted plans and specifications for two bridges at this place.

Hamilton Co., O.—Bids are asked for the construction a wrought iron bridge over Cluff Creek, Hamilton Co.,

Cincinnati, O.—Bids are asked for the construction of a masonry bridge over the Cincinnati and Hamilton turnpike. Address Arthur B. Hobby, C. E., 227 Main street, Cincinnati, O.

Memphis & Charleston R. R.—The Edgmore Bridge Company, contractors for the Drawbridge span of the Memphis & Charleston Railroad, have received twenty car loads of iron trestling from the Shelby Iron Works, of Alabama. Work on the bridge will commence in a few days and the draw will be finished inside of two months.

Louisa, Ky.—A bill has been introduced in the Kentucky Legislacure to incorporate the Louisiana & Cassville Bridge Co.

Itasca Co., Minn.—The County Commissioners will receive bids June 21 for a combination wood and iron bridge across Prairie River.

Yanktown, S. D.—A company will be organized to build a pontoon bridge at this place.

McKinney, Tex.—The county commissioners will construct an iron bridge over the Trinity River.

Canals.—***Citrus Co., Fla.***—H. W. Martin, T. J. Cochran, A. D. Tompkins and others have purchased the canal owned by the Florida, Orange Canal & Transit Co., connecting the Withlacoochee river with the Isala Apopka lakes, 800 acres of adjoining land, and the town site of Inverness for $66,000, and will, it is stated, extend the canal from the upper Apopka lake to the Withlacoochee river again, above Dunnellon.

The Woodland Canal Co. has been chartered at Tyrone, Pa. The directors are: J. M. Keck, Wm. G. Keck, H. E. D. Keck, Kecksburg; John C. Ewing, Tyrone; Leonard Keck, Greensburg; A. E. Woolridge, Woodland; Thomas Allen, Philadelphia.

Shelburne Falls, Mass.—Proposals will be received by D. W. Temple, Secretary Bridge Committee, for building a riveted lattice highway bridge, having 3 spans of about 100 ft., over the Deerfield River, until June 12. Application for plans and specifications should be made to Edward S. Shaw, Consulting Engineer, 146 Franklin St., Boston.

CONTRACTING.

Sewer Work.—Chattanooga, Tenn. Smith & Neely have received contract at $41,411.13 to construct pipe sewers and the Washington street brick sewer.

Cement and Bricks.—The following bids were opened at the office of the engineer of the ninth lighthouse district, April 30, for 50 bbls. of Portland cement and 1,000 bricks for use at the Point Betsy, Mich., Light Station: A. Hearnes & Sons, Detroit, cement, $162.50; bricks, $7.50, accepted. C. H. Little, Detroit, cement, $175; bricks, $6. S. Bedford, Manistee, Mich., cement, $200; bricks, $10.

Buildings.—Leeds, Iowa. The Berlin Bridge Co. has a $10,000 contract for building the three truss roofs for the new stove works here.

Newport, Ky., has let the construction of a new school building to Reil & Co. for $27,470. The highest bid was $29,900.

Manchester, Va. The contract for building works for the Baltimore United Oil Co. was awarded to W. O. Burton, for $10,734.

Tacoma, Wash. Chief Engineer Kendrick has awarded the contract for the Northern Pacific R. R. shops to A. McMullen & Co., of Minneapolis. There are 26 buildings to be erected, including a roundhouse of 22 stalls.

North Bend, Neb., is to vote soon for the issue of bonds for the erection of a city hall.

Duluth, Minn. The contract was let on May 21 to O. G. Traphegan for building a $300,000 theater and office building; it will be 125 x 140 ft. and seven stories high.

Levee.—The Board of Public Works, West St. Paul, Minn., has let the contract for the West Side levee, about 1 mile long, to Thornton & Shaw. The levee will be 13½ ft. above the level of the river, and will require about 10 ft. of filling.

Greenville, Miss.—William Starling, Chief Engineer of the Mississippi Levee District, will receive proposals for levee work after the water recedes.

Brick.—The Commissioner of Supplies, St. Louis, Mo., has awarded a contract for furnishing 10,000 brick to the Street Department to the Union Pressed Brick Co., at $10.05 per 1,000.

Street Work.—Baltimore, Md., Contracts have been awarded for furnishing material for repaving with Belgian blocks Cathedral St. from Center to Saratoga St, as follows: To William F. Weller, 21,000 blocks at $60 per thousand; Guilford & Wattersville Co. 50,000 at $64.40 McClenahan & Bro., 50,000 at $64.50; Oliver & Peach, 840 feet of curbing at 76 cents per linear foot and 6-inch circles at 85 cents per linear foot; John Harris, 2,100 feet of gutter stones at 22 cents per linear foot.

West Troy, N. Y.—The contract awarded last week to Malone & McKeena was confirmed and a bond given for $30,000 for its faithful performance.

Washington, D. C.—The contract to furnish 100,000 asphalt paving blocks has been let, it is stated, to the Maryland Paving Co. at $71 per M.

Brooklyn, N. Y.—The contracts for grading and paving Hull St. were awarded on May 12 as follows:—with cobblestone pavement, Harris & Maguire, per running foot, $5.62; Dennis Norton, per running foot $5.47; Charles Hart, per running foot, $4.46; Luck & Filzerald, per running foot, $3.85;

The contract for paving Bergen St., Brooklyn, with cobble stone, was awarded to John Mealey at $2.85 per running foot. The next lowest bid was $2.99, and the highest bid was $4.45.

Ottawa, Ont.—Tenders for paving were accepted as follows: F. D. Lawrence, sidewalk flags, supplied and laid on 4 ins of sand and joints cemented, 4 ft. by 2 ft., by not less than 2½ ins. thick, $2.48 per sq. yd.; 6 ft. by 3 ft. or over, by not less than 3 ins. thick, $3.75; extra size, 25 ft., or over in superficies, by not less than 4 ins. thick $4.45. Messrs. Desormeau Bros., gray limestone curb, stones, straight, 6 in. by 20 in. and 3 ft. long, 55 cts. per lin. ft.; do. curved, 60 cts.; straight, 9 in. by 12 in. by 4 ft. long, 65 cts.; do. curved, 75 cts. Mr. F. D. Lawrence, sidewalk flags, 4 ft. by 2 ft. by not less than 2½ in. thick, $1 65 per sq. yd.; 6 ft. by 3 ft. or over, by not less than 3 in. thick, $3; extra size, 25 ft. or over, in superficies, by not less than 4 in. thick, $3.50; crosswalk flags, 20 ins. wide by not less than 5 in. thick by not less than 3 ft. long, 80 cts per lin. ft.; do. 24 ins. wide by not less than 6 in. thick by not less than 3 ft. long, $1.00. The following tenders were accepted for laying: Mr. F. D. Lawrence, curbstones, 9 in. by 12 in., hauling and laying on 6 in. of concrete, 35 cts. per lin. ft.; 6 in., hauling and laying to grade, 15 cts.; 6 in., taking up and relaying to new grade, 15 cts.; over 24 in. deep, taking up and relaying to new grade, 31½ cts.; 4 in. by 5 in., taking up and relaying to new grade, 13 cts. Flagstone sidewalks, hauling and laying all sizes and cementing joints with Portland cement, 50 cts. per sq. yd.; taking up, cutting, fitting and relaying all sizes and cementing joints with Portland cement, 32 cts.; taking up, cutting, fitting and relaying Montreal stone and cementing joints with Portland cement, 30 cts. Flagstone crossings, hauling and laying all sizes, 13 cts. per lin. ft.; taking up, cutting, fitting and relaying all sizes, 7 cts.

Bristol, Tenn.—Tenders for laying 32,000 sq. ft. of artificial stone pavement were as follows:

	Sidewalks. Sq. ft.	Guttering. Sq. ft.	Curbing. Sq. ft.
Atlantic City Paving Co.	$0.23½	$0.24	$0.40
W. C. Murray	0.40	0.35	0.35
Owen Patterson	0.31	0.31	0.31
Osborne-Remington Co., Cincinnati, O.	0.22	0.22	0.22
Cohen Pavement Co., New York	0.23¾	0.23¾	0.23¾
Isaac S. Filbert, Baltimore, Md.	0.23¾	0.23¾	0.23¾
Miller Paving Co., Memphis, Tenn.	0.20	0.20	0.20

The contract was awarded to the Miller Paving Co., of Memphis, Tenn.

Dredging.—The Green Dredging Co. has secured the annual contract for the dredging of the Chicago River, at Chicago. Fitzsimons & Connell and the Chicago Dredging & Dock Co. also secured a portion of the work. The total bids for all the sections of the river advertised to be dredged were: Fitzsimons & Connell, $168,102; Chicago Dredging & Dock Co., $162,989; the Green Dredging Co., $161,868.25. The work was let out in sections, however, and as Fitzsimons & Connell were the lowest bidders for section 5 they were given that portion of the work for $47,520. The Chicago Dredging & Dock Co. got the contract for section 9, all the bids being equal.

County Roads.—The following is the result of a call for tenders for grading and macadamizing, 14 ft. in width, of Morris and Springfield and other avenues through the townships of Summit and Westfield and the city of Rahway in Union County, N. J. F. A. Durham, C. E., of Plainfield, N. J., is the engineer in charge of the work.

Avenue.	Name of bidder.	Sq. yds. pavement.	Price per sq. yd.	Cu. yds. excavation.	Price per cu. yd.	Cost. Pavement.	Cost. Excavation.	Total.
Morris and Springfield avs., Township of Summit..		27,457		3,541				
	John A. Hicks....		.75		.35	$20,592 75	$1,239.35	$21,832.10
	E. N. Lynch.....		.82		.30	22,514.74	1,062.30	23,577.04
	T. A. Nevins*....		.65		.30	17,847.05	1,062.30	18,909.35
Springfield Ave., Township of New Providence.....		9,643		2,616				
	John A. Hicks....		1.10		.35	10,607.30	915.60	11,522.90
	E. N. Lynch.....		1.18		.30	11,378.74	784.80	12,163.54
	T. A. Nevins*....		.90		.30	8,678.70	784.80	9,463.50
Central Ave., Township of Westfield.		13,261		2,921				
	John A. Hicks....		1.15		.35	15,250.15	1,022.35	16,272.50
	B. M. & J. F. Shanley.....		1.00		.40	13,261.00	1,168.40	14,429.40
	E. N. Lynch.....		.90		.30	11,934.90	876.30	12,811.20
	Huffman & Hetfield*.....		.80		.25	10,608.80	730.25	11,339.05
Central Ave., Township of Clark. ...		12,468		2,031				
	John A. Hicks ..		1.20		.35	14,961.60	710.85	15,672.45
	B. M. & J. F. Shanley*.....		.97		.40	12,093.96	812.40	12,906.36
	Edward N. Lynch		.98		.30	12,218.64	609.30	12,827.94
Central Ave., City of Rahway.....		4,040		682				
	John A. Hicks....		1.20		.35	4,848.00	238.70	5,086.70
	B. M. & J. F. Shanley*.....		.84		.40	3,393.60	272.80	3,666.40
	Edward N. Lynch		1.10		.45	4,444.00	306.90	4,750.90

*Successful bidders.

PROPOSALS OPEN.

Grading.—Sixty-five miles of grading on the Paducah & Tennessee R. R. Johnson Bros. & Fraught, Paducah, Ky. No date specified.

Water Bonds.—To the amount of $125,000, bearing 4½ per cent. interest. Henry F. Ellis, City Clerk, St. Thomas, Ont. June 16.

Foundations.—For a stand-pipe, pumping station, and chimney. E. H. Reynolds, Water Commissioner, Brockton, Mass. June 7.

Bridge.—For constructing a masonry bridge on the Cincinnati & Hamilton Pike, one mile north of Mt. Healthy. Arthur A. Hobby, C. E., Cincinnati, O. June 9.

Bridge.—For constructing a wrought-iron bridge on Cluff road, over Cluff Creek, near Cluff's school house Anderson Township, Hamilton Co. Fred Ranie, Auditor Hamilton Co., O. June 7.

Bridge Repairing.—For repairing Union Bridge levee Plans and specifications on file. Fred. Ranie, Auditor Hamilton Co., O. June 28.

Water Bonds.—B. W. Roscoe, City Treasurer, Syracuse, N. Y. Amount, $500,000; 30 years; interest, 3 per cent. June 9.

Life Saving Station.—For constructing a new life saving station at Great Neck, Nantucket. Bids to be opened in Washington, D. C. June 5.

Railway Work.—Grading, trestling, crossties, masonry, and track-laying on the first division of the South Bend Ry. B. A. Denmark, President, Savannah, Ga. Bids received any time after June 10.

Bridge.—Combination wood and iron bridge across Prairie River. The Board of County Commissioners of Itasca Co., Minn. June 21.

Wharf Repairing.—Robert E. McMath, President pro tem. Board of Public Improvements, St. Louis, Mo. June 6.

Sewers.—Albert L. Lincoln, Jr., Chairman, Brookline, Mass. June 2.

Jail.—City Clerk, Olathe, Kan. June 21.

Street Work.—Louis Reemelin, President Board Public Improvement, Cincinnati, O. June 16.

Building.—Alumni Hall of Knox College, J. A. Adams, Chairman Alumni Association, Galesburg, Ill. June 10.

Sewers.—John P. Adams, Commissioner, Brooklyn, N. Y. June 1.

School Building.—W. W. Smith, District Clerk, Sleepy Eye, Minn. June 10.

Granite Blocks.—For furnishing 28,000 tons of granite blocks for street paving. W. L. Lyons, Mayor pro tem Louisville, Ky. June 5.

Grading and Graveling.—Seven Mile Beach Co., 40 So. 3rd St., Philadelphia, Pa. No date specified.

Pier.—Commissioner of the Department of Docks New York, N. Y. June 6.

Sewers and Brick Paving.—City Clerk, Pekin, Ill. June 5.

Repairing Docks, Dredging, Etc.—Commissioners of Department of Docks, New York, N. Y. June 11.

Artesian Well.—Henry Sales, Abilene, Tex., will open bids on June 2 for drilling an artesian well "to water."

MANUFACTURING AND TECHNICAL.

The Marion Steam Shovel Co., of Marion, O., on May 20, booked orders for four of its largest steam shovels, one large 2-yd. dredge, one ¾-yd. dredge, one ditching dredge and several ballast loaders. Two of the steam shovels are for the New York, New Haven & Hartford R. R. Co., making four now in use by this company. The Marion Co. also report recent shipments to about a dozen other railroad companies, contractors, etc.

Car-Wheels.—The Truss Car-Wheel Co., of Edwardsville, Ill., has decided to put in a much larger plant than was at first intended. The plans for the buildings are now ready, and as soon as the specifications can be prepared the contracts will be let for the erection of the buildings. The grading is completed, and the switch-grade is ready for the ties. The Wabash Co. will lay the track.

Projectiles.—The Carpenter Steel Co., of Reading, Pa., has a $200,000 contract from the Navy Department for armor piercing projectiles of different calibre.

Shipbuilding.—A company is being formed in New Bedford, Mass., to establish a plant for building iron and steel sailing ships and steamers. The proposed vessels are to be of large carrying capacity and fitted with modern improvements.

Boiler Tube Scraper.—The H. S. Ingalls self-adjusting boiler tube scraper, manufactured and sold by William C Codd, 2010 Aliceanna St., Baltimore, Md., has a covered spiral spring, thus protecting it from the influence of heat and dirt; a movable nut on the end of scraper rod, so that the tension of spring may be readily and instantly changed, is self-centering, and in consequence of tapering from each end toward the centre it never catches on the rear end of tubes; it cleans while passing both ways in the tubes, the scraping arms are made of cast-iron, with chilled working edges, and are thus more durable than steel, as they never neal from the effects of heat, and the spring cannot drop out except by first unscrewing the nut on the end of scraper rod.

Car-Works.—A $500,000 stock company is being organized at Macon, Ga., to build car works. J. S. Baxter can give information.

The W. N. Y. & P. R. R. Co. will, 'tis said, remove its car works from Olean to East Olean. The Buffalo shops may be removed to the same place.

The Steel Trust Car Wheel Co. will erect shops at Edwardsville, Ill. They will, it is reported, be situated on the Wabash Railway, and will be connected by that line and the Madison County Railroad with all the Eastern roads out of St. Louis.

The American Fire-proof Steel Car Company, of Alabama, was chartered May 10, 1890, with capital stock of $1,500,000. President, John S. Long, of Louisville, Ky.; Secretary and Treasurer, R. C. Johnson, of Atlanta; General Manager, F. H. Foster, formerly of Florence, but now of Bridgeport, Ala. The plant will be at Bridgeport. The work has commenced with a force of 100 men, which will be increased as rapidly as labor can be secured.

The Mount Vernon Car Manufacturing Co., has been organized at Mount Vernon, Ill., for the purpose of building works for the manufacture of cars. Buildings will be erected at once.

The plans and specifications for the new shops and engine house to be erected by the Illinois Central Railroad near those now in use, have been formally approved and turned over to the contractor, Jno. J. Dunnavant & Co.

The shops of the Louisville, Evansville & St Louis road will probably be removed from Huntingburg to Mt. Carmel. The citizens of Mt. Carmel have offered $75,000 as a subsidy if the shops are located there.

Chicago Supplemental Car-Body Company has been incorporated; location, Chicago; for the manufacture of supplemental and adjustable car-bodies; capital stock, $250,000; incorporators, William Borner, Lyman Blair, and Tracy C. Drake.

The Goldie Spike Co has sent 1,000 kegs of its spikes to the Wyoming Improvement Co. for use on the Pacific Short Line. Dilworth, Porter & Co., of Pittsburgh, have put in a new 9-in. guide mill to increase the rolling capacity about 30 tons per day. New spike machines have been added to make the Goldie Perfect spike, which will bring the output of that brand to 275 200-lb. kegs per day.

Signal Factory.—A company has been organized in Marion, Va., with W. A. Carpenter, of Saltville, president; W. C. Pendleton, general manager; J. W. Richardson, secretary; J. S. Copenhaser, treasurer, to manufacture an automatic danger signal, the capital stock to be not less than $100,000 nor more than $500,000.

Gearon Metallic Railway Track Sleeper Co., Chicago, has been incorporated to manufacture patent track sleepers; capital, $300,000; incorporators, H. V. Jurtz, Thomas Darwin, Isham Randolph.

The New Open-Hearth Steel Plant of the W. Dewees Wood Co., at McKeesport has been tested. The furnaces are "open-hearth," with a capacity of 30 tons each daily. The test is very satisfactory, and the new mill will now be in operation right along.

Makers of Water Motors should address Mr. R. L. Jennings, Marshall, Tex.

Six Hennessey Boilers, made by the R. F. Hawkins Iron Works, of Springfield, Mass., are showing remarkable results at the Kimberly & Clark paper mills, Appleton, Wis. Each of these boilers is six feet in diameter and 17 ft. 6 ins. long, with two double drafts 11 ft. 6 ins. and 15 ft. long respectively. Each boiler shows an evaporation test of 4,000 to 6,000 pounds of water per hour. Another test was made with two boilers, one being run five hours and the other seven hours. The amount of water evaporated by both boilers was 133,000 pounds; the amount of coal used was 1,292 pounds, with eight-ninths of a cord of wet bass-wood slabs, and the balance of the fuel was wet shavings. The entire plant was designed by D. H. & A. B. Tower, of Holyoke, Mass.

The Midway Iron Co. has been chartered with a capital of $300,000, to make spikes, nails, bolts, etc. C. O'Leary, President; E. F. Cole, Secretary and Treasurer. The company will erect at once a plant on lands donated by the Midway Land Co., between Roanoke and Vinton, W. Va.

Bessemer Pipe Works.—Thomas Howard and John W. Harrison, of the Shickle, Harrison & Howard Iron Co., of St. Louis, Mo., will build pipe works at Bessemer, Ala. A site has been selected and contract for excavating and grading awarded. The main building is to be 80 × 1,000 ft., and will, with other buildings, storeyards, etc, cover about 40 acres of land. Capacity of plant is to be 200 tons per day, and it is expected to commence operations by Oct. 1. It is stated that contract for furnishing 13,000 tons of piping to Denver (Col.) parties has been already closed.

Cars.—The Indianapolis Car Works has commenced a contract to build 1,500 cars for the Columbus & Hocking Valley road. The intention is to turn these cars out at the rate of 200 a week.

The Reading Railroad is receiving from 100 to 200 coal cars a week from the order of 4,000 recently placed with the Pullman company. The whole order will be delivered by the middle of summer.

The United Rolling Stock Co. have contracted to build for the Wisconsin Central Railroad 1,000 25-ton ore cars. These cars are all to be fitted with Janney couplers and the Westinghouse automatic brakes; 500 will be supplied with the National hollow brake beam and the balance with the Marden brake beam. The Wisconsin Central has also issued instructions that hereafter all freight cars going into the shop for general repairs shall be equipped with the Janney couplers.

The Baltimore & Ohio Railroad is about to order 2,000 new freight cars. The company expects to receive the first consignment of a number of passenger cars in a few days.

The Georgia Central R. R.'s order for 1200 new freight cars is nearly filled.

The St. Louis car works are delivering new cars to the C. C. C. & St. L. R. R. Co. at the rate of 100 a week. These cars are provided with the Janney coupler and air-brakes, and are a superior car in every respect.

Birmingham, Ala.—The Birmingham, Powderly & Bessemer Street R. R. Co. will buy dummy cars. B. Steiner is president.

Vestibule Car Patents.—A suit in equity was commenced May 22, in the United States Circuit Court in Boston, in the name of Henry Walter Webb, Trustee for the Wagner Palace Car Co., against the Pullman Palace Car Co. and the New York & New England Ry. Co. for an injunction to restrain the joint use by the defendants on the New York & New England road of Pullman cars containing improvements in car platforms, patented by Philip Hien and "Improvements in combined car buffers and yielding platforms," patented by Clinton Browning. The infringing platforms and buffers enter into the construction of all Pullman vestibule cars now running.

The Lima Car-Works are building 235 tank cars for the Manhattan Oil Co.

Locomotives.—The Baldwin Locomotive Works have just delivered to the Cincinnati, Jackson & Mackinaw road five large freight engines. They were built at the company's branch works in New York, and are said to be very creditable to the new shops. The Baldwin company has also delivered to the Baltimore & Ohio R. R. six consolidation engines, and six more of a similar pattern will be ready soon.

The Schnectady Locomotive Works turned out last week two engines for the T. S. & V. R. R.

The Woolf valve gear has been put on engine No. 72 of the C., St. P., M. & O. R. R. The same gear has been on engine No. 132 for some time, and is reported as giving much satisfaction in showing an economy in fuel and increased hauling capacity.

The Baltimore & Ohio R. R. Co. has under consideration the giving out of a contract for 25 more consolidated locomotives.

The Georgia Central R. R. has just received 20 new engines, and 20 more will be delivered before July. Half of these engines already received are freight, two are passenger, and the remainder shifting engines. The new engines are Baldwin make, and weigh 115,000 lbs. each. The most of them will be used on the Central's main stem. The others will be placed on the other stems, the Southwestern, the Savannah & Western and the South Carolina divisions. They will displace a good many light engines, which will be transferred to the branch roads, the Milledgeville, the Talbottom and other branches.

The Link Belt Machinery Co. are building a new machine shop at Chicago, Ill. It will be of iron, designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 121 ft. wide. The central portion will be 40 ft. wide by 42 ft. high with a traveling crane running the entire length. The wings will be 40 ft. in width and two stories high. A hydraulic crane will cover the entire central portion of the building except, for a distance of 30 ft. from one end, which will be used for offices.

Omaha Paving Brick Co.—Articles of incorporation of the long-expected Omaha Vitrified Paving Brick and Tile Co. have been filed with the Secretary of State. The capital stock is to be $100,000. The corporation is for the period of 25 years. The incorporators are: Frank Murphy, Andrew Rosewater, S. O. Huntoon, George Higgins, and Newman S. Clark.

Steam Road-Rollers.—Aveling & Porter steam road-rollers have, during the last week, been purchased by Methuen, Mass.; Mount Vernon, N. Y. R., and Lenox, Mass.

Fences.—The American Electric Fence Co., of Chicago, has been organized by E. F. Fish, E. L. Ingalls and F. Babcock. Capital stock, $300,000.

Car Couplers.—The National Freight Car Coupler Co. has been organized at Chicago by R. D. Slosson, F. C. Crowley and C. L. Easton. Capital stock, $100,000.—A company has been organized at Roanoke, Va., to manufacture the Joo car coupler. President, Dr. E. A. Parsons; Secretary, F. T. Brinkley.

Triple Expans on Engines.—The E. P. Allis Co., of Milwaukee, Wis., has been awarded the confract for furnishing three triple expansion Reynolds-Corliss engines of 1,000 h. p. each, to be used in connection with the new electric street railway lines at St. Paul. This plant and the one being put in for the Minneapolis system represent a cost of about $175,000.

Steel Brake Beams.—The Michigan Railway Supply Co., of Detroit, will furnish the New York Central R. R., with the "Central" steel brake beam for 6,000 cars. This beam is to be used in connection with the Buchanan truck and the Westinghouse brake.

Rails.—The Allegheny Bessemer Steel Co. has a contract for 10,000 tons of standard rails for the Atchison, Topeka & Santa Fe R. R. They are to be delivered by September. It is believed that a portion of these rails are to be used in the extension of the Silver City branch, whose junction with the main line is at Denning, N. M.

Ballast.—The Western Burnt Brick, Ballast & Paving Co., of Cameron, Mo., has been incorporated by Chas. W. Schneider and P. D. Watson, of Cameron, Mo., Jesse C. Stubbs, and James C. Stubbs, of Mount Pleasant, Ia. Capital stock, $10,000.

Railway Supplies.—The Cook Railway Supply Co., of Chicago, has been incorporated by B. L. Cook, G. D. Cook and A. E. McCue. Capital stock, $250,000. The Western Appliance Co., of Chicago, has been incorporated by C. A. Schroeder, J. N. Whitman and F. O. Cordo.

Building Iron.—The iron for the new buildings of the Daniel E. Paris Stove Co., at Sioux City, Ia., will be furnished by The Berlin Iron Bridge Co., of East Berlin, Conn. The foundry building will be 155 ft. wide by 350 ft. long; the mounting room 87 ft. wide by 225 ft. long, and the boiler, engine, and plating room 50 ft. wide by 196 ft. long. The Berlin Iron Bridge Co. also have the contract for the new foundry building of The Waterbury Farrel Foundry and Machine Co., at Waterbury, Conn.

Metal Market Prices.—*Rails*—New York: $31.50, old rails, $23.50 to $24 for iron, $19 to $19.50 for steel. Chicago: $35; old rails, $23.25 for iron, $21 for steel. Pittsburg: $31 to $32; old rails, $23.50 to $24.50 for iron; $20 to $20.50 for steel.

Track Materials.—New York: steel angle bars, 1.75 cts.; spikes, 1.95 to 2 cts.; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.80 to 1.90 cts. for iron; spikes, 2.05, or 2.15 cts. delivered at Chicago or St. Louis; track bolts, 2.85 to 2.90 cts., with square, and 2.95 to 3 cts. with hexagon nuts. Chicago: splice bars, 1.90 to 2.20 cts. for steel, and 1.95 to 2.05 cts. for iron; spikes, 2 cts.; track bolts, 2.85 to 3 cts., with hexagon nuts.

Pipe.—Cast-iron, about $27 to $30 per ton, according to competition and amount of order. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York 4.35 cts.; Chicago, 3.85 to 3.95 cts.; St. Louis, 3.75 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for firebox; 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.90 cts. for tank.